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IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.C.S.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Preliminary Researches on Thallium, *by* WILLIAM CROOKES, *F.C.S.*

(Abstract of a Paper read before the Royal Society, June 19, 1862.)

THE occurrence of a brilliant green line in some selenium residues, whilst examining them for tellurium, led me first to suspect the presence of a new metal. In March, 1861,* I announced definitely that the green-line substance was decidedly a new element. The paper alluded to contained a sufficient number of the reactions of this body to enable me to prove chemically, as well as optically, that I was dealing with an element possessing well-defined characters. Pursuing the investigation, I was enabled in the following May,† to give a further account of this body, and to propose for it the name of *Thallium* (symbol, Tl). In the same note I gave the localities and description of several minerals in which I had found the element, and also a method of extracting it from them in a pure state. Considering that I had sufficiently announced the discovery in these papers, which were republished in nearly every Chemical Journal in Europe, I turned my attention towards procuring a source of thallium which would enable me to prepare this body on the large scale, my experiments having hitherto been confined to mineralogical specimens, which I had difficulty in tracing to their source, and the whole amount of thallium which I had as yet obtained not exceeding three grains in weight.

After some delay, Mr. Thornthwaite was good enough to supply me with a considerable quantity of crude sulphur distilled from Spanish copper pyrites. In this I found thallium present to the extent of one or two grains to the pound, and up to within the last few months, it has been from the element prepared from this source that I have been working. I have recently, however, succeeded in finding an ore containing thallium, which is worked in this country, and from which I hope to be able to prepare the metal in larger quantities.

I have found the following the most advantageous method for extracting the new element from sulphur or pyrites:—

Powder the ore very finely, and dissolve as completely as possible in strong hydrochloric acid, with gradual addition of nitric acid, until all solvent action ceases; then dilute with water and filter. Evaporate down, to drive off the excess of nitric acid, adding a little sulphuric acid if necessary, and taking care that the solution does not get dry, or even pasty. Then dilute with water and heat gently, to be certain of getting all the soluble portion dissolved. Filter; if lead be present, the greater portion will be left behind in this operation in the form of insoluble sulphate. Dilute the filtrate considerably, and add a solution of carbonate of soda until the reaction is distinctly alkaline; then add an excess of solution of cyanide of potassium (free from sulphide of potassium). Heat gently for some time and then filter. The precipitate contains the whole of the lead and bismuth which may be present, as carbonates, whilst the thallium is in solution. A current of sulphuretted hydrogen now being passed through the liquid precipitates all the thallium, whilst the copper, antimony, tin, and arsenic remain dissolved. If cadmium and mercury are present they will accompany the thallium. The former can readily be dissolved out by warm dilute sulphuric acid, which has scarcely any solvent action on the sulphide of thallium, whilst this in its turn can be separated from the sulphide of mercury by being boiled in moderately dilute nitric acid, in which the sulphide of mercury is insoluble. These two metals are, however, seldom present with thallium in the ores which I have examined. The nitric acid solution is now to be evaporated to dryness, the residue dissolved in hot dilute sulphuric acid, and a piece of pure metallic zinc placed in the liquid; the thallium will be at once precipitated in the form of a deep brown powder, which soon changes to a heavy, black, granular precipitate. The metal can be obtained in the coherent form by fusion in hydrogen.

This method of analysis is given on the supposition that all the above metals are present. It may generally be much abridged, as the ore is seldom of so complicated a character. If there is a difficulty in procuring perfectly pure zinc for the reduction of the sulphate to the metallic state, this can be effected by passing a weak voltaic current through the liquid, using platinum poles; the metal will then be precipitated in the reguline or spongy state, according to the strength of the current. I have not been very successful in reducing the oxide by hydrogen. The current of gas carries the volatile oxide away from the heated part of the tube before complete reduction takes place. It is, however, probable, from an observation made towards the conclusion of this experiment, that with a longer tube in proportion to the quantity of material, kept at a good heat throughout its length, this plan might give good results, the metal being considerably less volatile than the oxide.

In many cases, when minute traces only of thallium accompany large quantities of other metals, it may be advisable to repeat the whole or some of the above operations in order to purify this element from foreign metals which may have escaped complete removal.

I now pass on to a description of thallium and its chemical reactions.

Thallium in the pure state is a heavy metal bearing a remarkable resemblance to lead in its physical properties. Its specific gravity is, however, higher—about 12. The freshly-scraped surface has a brilliant metallic lustre, not quite so blue in colour as lead, and it tarnishes

* *Philosophical Magazine*, Fourth Series, vol. xxi. p. 301, and CHEMICAL NEWS, vol. iii. p. 194, March 30, 1861.

† CHEMICAL NEWS, vol. iii. p. 303, May 18, 1861.

more rapidly than this latter metal. It is very soft, being readily cut with a knife and indented with the nail; it may also be hammered out and drawn into wire, but has not much tenacity in this form. It easily marks paper. The fusing point is below redness, and with care several pieces may be melted together and cast into one lump. There is, however, generally a loss in this operation, owing to its rapid oxidation. The metal itself does not appear to be sensibly volatile below a red heat. I have made no special attempts, at present, to determine the atomic weight, although, from two estimations of the amount of sulphur in the sulphide, it appears to be very heavy. The figures obtained did not, however, agree well enough to enable me to speak more definitely on this point, than that I believe it to be above 100. I may mention that I obtained this element in the pure metallic state, and exhibited it to several friends as early as January last,‡ and should then have published an account of it, had it not been for the reasons already mentioned. Thallium is soluble in nitric, hydrochloric, and sulphuric acids, the former attacking it with greatest energy, with evolution of red vapours.

Oxides of Thallium.—Thallium forms two, and probably three oxides: one possessing basic properties, which I shall call the oxide; another containing more oxygen, possessing acid properties, which may, therefore, be called thallic acid; and, most likely, a third, or sub-oxide, which forms the first portions of the precipitate given by zinc in solutions of this metal; the first action being a darkening of the solution, and the production of a deep brown powder, which, by longer contact with zinc, turns to a dense black precipitate.

Upon carefully evaporating the nitric acid solution upon a water bath, but not carrying it to dryness, a mass of deliquescent crystals is obtained on cooling, which are decomposed upon addition of water with separation of a white or pale yellow precipitate, which appears to be a subnitrate, and an acid solution containing nitrate of thallium. If the liquid is evaporated quite to dryness, and kept at a temperature of 100° C. for a little time, the nitric acid goes off, and leaves a residue of thallic acid.

Thallic Acid.—This acid is soluble in water, and may be obtained in the crystalline form from its aqueous solution. It then forms crystals, which are permanent in the air and have an acid reaction to test-paper. The thallates of the alkalies are also soluble in water, and may be prepared by dissolving the acid in the alkali, or by fusing thallium or its oxide with a mixture of alkaline carbonate and nitrate. The method I originally published for extracting thallium was based upon the formation, in this manner, of an alkaline thallate soluble in water. This acid is also produced in solution when permanganate of potash is added to a soluble salt of oxide of thallium.

Chloride of Thallium.—If a current of dry chlorine is passed over precipitated thallium at a moderate heat, they combine with formation of a volatile chloride, which condenses in the cool part of the tube in the form of a pale yellow crystalline powder, fusing together in part to a crystalline lump. Water only partially dissolves this, with production of a white insoluble residue. Dilute hydrochloric acid added to the turbid solution immediately renders it clear. Upon evaporating this solution over a water bath, white crystals are deposited. When the nitric acid solution of thallium or its sulphide is evaporated with an excess of hydrochloric acid, and then more hydrochloric acid added, and the evaporation repeated to a syrup, a residue is obtained which is apparently decomposed by water with production of a white precipitate. This is chloride of thallium; it is insoluble, or nearly so, in water, but readily soluble in dilute hydrochloric or nitric acid.

Sulphide of Thallium.—When sulphuretted hydrogen is passed through the acid solution of chloride of thallium, a partial precipitation of a reddish-brown powder takes place. This appears to be a combination of the chloride and sulphide, and the metal is never entirely removed from solution by this means. The best method of obtaining the sulphide is to precipitate it with sulphide of ammonium in an alkaline solution. Unless a large quantity of thallium is present no immediate effect is produced beyond the darkening of the liquid; it assumes a brown tint, which becomes rapidly more and more intense, especially upon gently heating it, until the sulphide of thallium separates in the form of a deep brown heavy precipitate, which shows a great tendency to collect together in clots at the bottom of the vessel; this formation of the sulphide is very characteristic of the metal. Sulphide of thallium is insoluble in an excess of sulphide of ammonium, ammonia, or cyanide of potassium. Its complete precipitation as sulphide from solutions containing an excess of cyanide of potassium affords a ready means of separating thallium from several metals with which it is frequently associated. It is difficultly soluble in hydrochloric or sulphuric acid, but readily so in nitric acid. When dry it is a deep brown, almost black, powder, fusing and volatilising when heated. When pure, it is neither so fusible nor so volatile as sulphur; but when it occurs with an excess of this latter element, it is very difficult to separate from it by sublimation.

Carbonate of Thallium is precipitated upon adding an alkaline carbonate to the acid chloride solution. It is moderately soluble in an excess of carbonate of ammonia, and readily so in cyanide of potassium. This is a very definite reaction, and enables thallium to be separated with accuracy from lead and bismuth.

Sulphate of Thallium.—When the hydrochloric or nitric solution is evaporated down with sulphuric acid, the more volatile acid is driven off, and the sulphate is left behind. It is soluble in water.

Iodide of Thallium is precipitated as a yellowish-red powder upon cautious addition of iodide of potassium to a solution of thallium. It is readily soluble in excess of iodide of potassium, forming a colourless solution.

Phosphate of Thallium forms a white flocculent precipitate, soluble in mineral acids, but sparingly soluble in acetic acid.

Ferrocyanide of Thallium is white and insoluble in water.

Cyanide of Thallium is precipitated as a white or light brown powder upon the cautious addition of cyanide of potassium to a solution of thallium. It is readily soluble in an excess of the precipitant.

Chromate of Thallium is a pale yellow precipitate, soluble in acids, and precipitated upon neutralisation with ammonia.

No precipitates are produced when a solution of thallium is mixed with *protochloride of tin*, *oxalic acid*, *carbazotic acid*, *sulphurous acid*, or *protosulphate of iron*.

Most of these reactions have been independently verified by my friends, E. O. Brown, Esq., and J. Spiller, Esq., of the Chemical Department, Woolwich Arsenal; and I am glad to be enabled to take this oppor-

‡ See Chemical News, vol. v. p. 349, 350.

tunity of expressing my obligations to them for their valuable aid. The reactions are sufficient to prove chemically that the body under examination is a new element. Its behaviour in the spectrum apparatus is perhaps the most conclusive test upon this point. When a minute portion of the sulphide, chloride, or, in fact, any compound of thallium is introduced into the flame of the spectroscope, it immediately produces a single green line, perfectly sharp and well-defined upon a black ground, and of extraordinary purity and intensity, almost equal to the sodium line in brilliancy. It is not, however, very lasting. Owing to its great volatility, a portion introduced at once into the flame merely shows the line as a brilliant flash, remaining only a fraction of a second; but if it be introduced into the flame gradually, the line continues present for a much longer time. If also a piece of metallic thallium be introduced into the flame on a platinum wire loop, they fuse together, and the alloy gives the green line rather more permanently, although, of course, fainter.

Working on a small scale, it is not easy to obtain these compounds free from soda; but when that is effected, and a tolerable quantity of substance is held on a loop of platinum wire in a flame, the green colour is most brilliant, and produces very extraordinary effects upon the appearance of surrounding objects. If thallium could be obtained in quantity, this ready means of producing an intense and homogeneous green light could not fail to be applicable to some useful purpose.

The green line of the thallium spectrum appears to be unaccompanied by any line or band in other parts of the spectrum. A flame of sufficient temperature to bring the orange line of lithium into view produces no addition to the one thallium line; and an application of telescopic power strong enough to separate the two sodium lines a considerable distance apart, still shows the thallium line single. I consider, therefore, that I am justified in stating that thallium produces *the simplest spectrum of any known element*. Theoretical inquiries into the cause of the spectrum lines and their relation to other constants of an element may be facilitated now we know a metal which gives rise to luminous vibrations of only one degree of refrangibility. The remarkable simplicity of the thallium spectrum offers a strong contrast to the complicated spectra given by mercury, bismuth, and lead, the metals to which it has the most chemical resemblance.

The position of the green line does not coincide with any definite line in the solar spectrum. According to Kirchhoff's theory, we must therefore assume that thallium is not present, at all events, to any great extent in the sun. Under the highest telescopic power of my apparatus, the line appears to be absolutely identical in refrangibility with a sharp, well-defined line in the barium spectrum, to which Professors Bunsen and Kirchhoff have given the name Ba δ. Want of material has hitherto prevented me from taking accurate measurements of the distance between the thallium line and the principal lines of the solar spectrum.

This green line is an exquisitely delicate test for the presence of thallium, and shows it to be a somewhat widely distributed element. Many specimens of crude sulphur contain it, especially when rather dark-looking. In most cases it is only necessary to set fire to as large a piece of sulphur (less than a pea) as the platinum loop will hold, and when it has nearly burned away, to blow it out, and then introduce it at leisure into the flame of the spectroscope, for the thallium to show its presence by a bright green line, which will flash for an instant into the field of view. Although the greater part of the thallium is left behind after burning off the excess of sulphur in this manner, some of it volatilises; and, consequently, if the specimen gives no indications of thallium by this treatment, it will be advisable to dissolve out as much of the sulphur as possible with bisulphide of carbon, and then to test the residue in the flame.

Thallium is a constituent of very many mineral ores. Upon examining a large collection of cupriferous pyrites from different parts of the world, I found it present in more than one-eighth. It is not confined to any particular locality, neither does it seem to bear any relation to the presence or absence of arsenic in the mineral. I have, however, very rarely met with it in pyrites in which copper was absent. For most cases, it is only necessary to powder a small fragment of the mineral and ignite a little of it in the flame, on a moistened platinum wire, for the green line to be distinctly visible.

If a thalliferous pyrites is finely powdered and then heated to redness in a glass tube as much as possible out of contact with air, the sulphide of thallium, together with some free sulphur, sublimes from it, and may be condensed by appropriate arrangement. This sublimate gives the thallium line with great brilliancy.

TECHNICAL CHEMISTRY.

On the Igniting Point of Coal-gas, by Dr. E. Frankland, F.R.S.*

The temperature at which coal-gas will ignite, under ordinary or extraordinary conditions, is a circumstance of considerable importance, both to manufacturers and consumers of gas; nevertheless, the recent explosion in Holborn, and the difference of opinion which evidently prevails, even amongst those who are intimately acquainted with the properties of coal-gas, prove that the subject has not hitherto received that attention which it obviously merits. Under these circumstances, the following experiments, and the conclusions drawn from them, although they are far from exhausting the subject, may not perhaps be altogether unacceptable as a contribution to this part of the history of coal-gas.

The heterogeneous mixture of gases and vapours, known as coal-gas, may, for our present purpose, be assumed to consist of:—

Olefiant gas, and other luminiferous hydrocarbons.
Light carburetted hydrogen, or fire-damp.
Hydrogen.
Carbonic oxide.
Bisulphide of carbon.

Now, under certain circumstances, these constituents can, to some extent, become separated from each other; and it is therefore desirable, at the outset of the inquiry, to examine separately their respective igniting points.

1. Olefiant gas, which may be taken also as the type of the remaining luminiferous hydrocarbons, could not be inflamed by a hot iron, unless the latter were heated until it appeared of a cherry-red colour in the daylight of a tolerably well-lighted room.

2. The igniting point of light carburetted hydrogen was carefully determined by Davy, to whose observations I have not a word to add. He says that "light carburetted hydrogen can be inflamed by white-hot sparkling iron, but not by iron at a red heat; it is, therefore, much less inflammable than hydrogen or car-

* From the *Journal of Gas Lighting*.

bonic oxide, and less so than olefiant gas." Bischof says that it cannot be inflamed by burning tinder, even though the tinder be strongly blown upon.

3. Hydrogen inflamed at a lower temperature than olefiant gas, but it could not be ignited by a rod of iron, unless the latter were heated to a temperature considerably beyond visible redness in a tolerably well-lighted room.

4. Carbonic oxide inflamed at a temperature somewhat greater than that at which hydrogen ignited, but lower than that necessary for the inflammation of olefiant gas.

5. Bisulphide of carbon vapour ignited at 300° F.

In some experiments recently made in connection with the gas explosion in Wood Street, I had occasion to observe that when coal-gas is allowed to mix with air contained in a space partly enclosed, but still communicating freely with the atmosphere, such as an open-bladdered gas-main, for instance, there occurred an approximate separation of the lighter from the heavier constituents of the gas; thus, samples of the explosive mixture taken from such a space were found on analysis to contain olefiant gas, luminiferous hydrocarbons, carbonic oxide, and bisulphide of carbon, with but a small per-centage of light carburetted hydrogen, and mere traces of hydrogen, although the two latter gases constitute, as is well known, the chief bulk of coal-gas. These gases must, therefore, have rapidly made their way out of the partially-enclosed space into the atmosphere. This behaviour of the different constituents of coal-gas, when the latter is slowly admitted into one end of an open main containing atmospheric air, may not inaptly be compared to that of a number of birds, of different powers of flight, entering at one end of the pipe, and making the best of their way towards the opposite extremity. At every moment from the entrance of the birds, the per-centage of those of swift flight would diminish near the entrance-end of the pipe, whilst that of the birds of slower velocity would obviously increase in the same ratio.

The Master of the Mint has proved that the rapidity with which gases diffuse into each other, or into a vacuum, is inversely proportional to the square roots of their specific gravities; and although there are some circumstances in the case of the open gas-main, or partially-enclosed space, which would somewhat interfere with this ratio, yet, for all practical purposes, Mr. Graham's law may be assumed to express correctly the different velocities with which the constituents of coal-gas would hasten to escape from the space in question.

These velocities of diffusion are as follow:—

Bisulphide of carbon . .	1
Olefiant gas	1·66
Carbonic oxide . . .	1·66
Light carburetted hydrogen :	2·19
Hydrogen	6·23

All other luminiferous hydrocarbons existing in coal-gas must have a diffusion velocity lower than that of olefiant gas.

Thus, the effect of diffusion of coal-gas in an open horizontal pipe, or other similar partially-enclosed space, would be to form an explosive mixture, at or near the open extremity of the pipe, and containing chiefly hydrogen as the combustible gas; whilst the explosive mixture, formed near the end of the pipe where the gas entered, would contain chiefly carbonic oxide, olefiant gas, and bisulphide of carbon.

It is obvious, from experiment No. 3, that the explosive mixture, formed near the mouth of the tube, would ignite at a somewhat lower temperature than that required for the ignition of an explosive mixture containing all the constituents of coal-gas. Still, even this more inflammable mixture could not be ignited below a red heat distinctly visible in the daylight of a room. It might, however, be expected that the explosive mixture, formed at the opposite extremity of the tube, would be capable of ignition at a still lower temperature, owing to the continued increase in the proportion of the highly inflammable but sluggish bisulphide of carbon, which could, doubtless, under favourable circumstances, increase to at least ten times the amount originally contained in the coal-gas. In order to ascertain the effect of the presence of a considerable per-centage of bisulphide of carbon vapour upon the inflammability of the constituents of coal-gas, and especially of carbonic oxide and olefiant gas, the following experiments were made:—

6. Carbonic oxide was mixed with about 3 per cent. of the vapour of bisulphide of carbon, and was then allowed to issue from a jet into the air. The jet of gas readily ignited on the approach of a glass tube containing oil heated to 410° F., the igniting point of the gas being probably not higher than 350° F.

7. Hydrogen, containing the same amount of bisulphide of carbon vapour, ignited by contact with a tube containing oil at 420° F.

Here, then, was a phenomenon which would seem to indicate the alarming possibility of the ignition, at a comparatively very moderate heat, of explosive mixtures of coal-gas and air; fortunately the next experiments entirely allay any apprehensions on this score.

8. Olefiant gas, impregnated with 3 per cent. of the vapour of bisulphide of carbon, did not inflame at a perceptibly lower temperature than when free from the admixture of the sulphur compound.

9. To the highly inflammable mixture of carbonic oxide and vapour of bisulphide of carbon, used in experiment No. 6, a minute trace (not 0·1 per cent.) of olefiant gas was added. Instantly the igniting point of the mixture was raised to that of pure carbonic oxide.

10. A similar experiment with the hydrogen mixture (No. 7) gave a corresponding result.

Thus, the extraordinary inflammability which is imparted to carbonic oxide and hydrogen by the vapour of bisulphide of carbon, is entirely removed by mere traces of olefiant gas; and it is probable that the other luminiferous hydrocarbons contained in coal-gas would produce the same effect. In order to complete this part of the inquiry, it now only remained to extend these experiments to coal-gas itself.

11. Coal-gas could not, even under the most favourable circumstances, be ignited at a temperature perceptibly below that described in experiment No. 4 as necessary for the inflammation of carbonic oxide.

12. When coal-gas was mixed with 3 per cent. of bisulphide of carbon vapour, its igniting point was not lowered in the slightest degree.

Having thus proved that any amount of diffusion and the presence of a large quantity of bisulphide of carbon can have but a very slight effect upon the inflammability of explosive mixtures of coal-gas and air, the following experiments were made to decide the disputed point whether coal-gas can be inflamed by sparks:—

13. Hydrogen was readily inflamed by sparks struck from flint and steel.

14. Carbonic oxide was also readily ignited in a similar way.

15. The mixture of coal-gas and air issuing from a wire-gauze burner was repeatedly and easily inflamed by the sparks struck from flint and steel.

These results are quite in conformity with the experience of gas engineers and managers, several letters from whom are now before me, describing the ignition of gas from the sparks elicited by the contact of a workman's pickaxe with stones, the chipping of a main, &c. The notion that coal-gas will not inflame under these circumstances has, doubtless, arisen from the impossibility of so igniting the gas of coal mines; but the combustible gas existing in British coal mines has been proved by very numerous analyses to be light carburetted hydrogen only, no trace of hydrogen, carbonic oxide, or olefiant gas being ever present in it. Now, the igniting point of light carburetted hydrogen, as has already been explained, is very much higher than that of the other combustible gases present in coal-gas, and hence, whilst the mine may be safely lighted by the "steel mill," the use of such an instrument in an explosive mixture of coal-gas would infallibly cause ignition. A word of warning as to the use of the safety-lamp in gas-works may perhaps not be here out of place. Even in the difficultly-inflammable fire-damp mixture of coal mines the Davy lamp was known by its inventor to be unsafe in certain conditions, as when placed in a strong draught or rapidly swung to and fro. Any degree of insecurity thus attaching to the safety-lamp in mines is increased tenfold when it is used in explosive mixtures of coal-gas, and hence it is highly desirable that the gauze of such lamps should be finer than that used in the miner's lamp, and also that the workmen should be stringently prohibited from placing the lamps in a draught of explosive gas, or swinging them to and fro, since the neglect of these precautions may easily cause disastrous explosions.

In conclusion, the results arrived at may be thus shortly summed up :—

I. Coal-gas cannot, even under the most favourable circumstances, be inflamed at a temperature below that necessary to render iron very perceptibly red-hot by daylight in a well-lighted room. But this temperature is considerably below a red heat visible in the open air on a dull day.

II. This high igniting point of coal-gas, even under circumstances favourable to ignition at a low temperature, is due in a great measure to the presence of olefiant gas and luminiferous hydrocarbons, which prevent any depression of the igniting point by the presence even of comparatively large quantities of bisulphide of carbon vapour.

III. The igniting point of explosive mixtures of the gas of coal mines is far higher than that of similar mixtures of coal-gas; consequently, degrees of heat which are perfectly safe in coal mines may ignite coal-gas; hence, also, the safety lamp is much less safe in explosive mixtures of coal-gas than in those of fire-damp.

IV. Explosive mixtures of coal-gas and air may be inflamed by sparks struck from metal or stone. Thus an explosion may arise from the blow of the tool of a workman against iron or stone, from the tramp of a horse upon pavement, &c.

V. Explosive mixtures of coal-gas may also be ignited by a body of a comparatively low temperature through the medium of a second body whose igniting point is lower than that of coal-gas. Thus sulphur, or substances containing sulphur, may be inflamed at a temperature far below visible redness; and the contact of iron below a red heat with very inflammable substances, such as cotton waste, may give rise to flame, which will then, of course, ignite the gaseous mixture.

On the History of Petroleum or Rock Oil. By T. STERRY HUNT, *M.A., F.R.S., of the Geological Survey of Canada.*

PUBLIC attention has lately been drawn to the petroleum furnished by the oil wells in Canada and the United States, and we have, therefore, thought it well to bring together some few facts which may serve to explain the origin of this and of similar substances, including naphtha, petroleum or rock oil, and asphalt or mineral pitch, all of which are forms of bitumen, the one being solid, and the others fluid at ordinary temperatures. These differences are, in many cases at least, due to subsequent alterations; the more liquid of these substances are mixtures of oils differing in volatility, and by exposure to the air become less fluid, and partly by evaporation, partly by oxidation from the air, eventually become solid, and are changed into mineral pitch. These substances, which are, doubtless, of organic origin, occur in rocks of all ages, from the Lower Silurian to the tertiary period inclusive, and are generally found impregnating limestones and, more rarely, sandstones and shales. Their presence in the lower palæozoic rocks, which contain no traces of land plants, shows that they have not been in all cases derived from terrestrial vegetation, but may have been formed from marine plants or animals: the latter is not surprising when we consider that a considerable portion of the tissues of the lower marine animals is destitute of nitrogen, and very similar in chemical composition to the woody fibre of plants. Besides the rocks which contain true bitumen, we have what are called bituminous shales, which when heated burn with flame, and by distillation at a high temperature yield, besides inflammable gases, a portion of oil not unlike in its characters to petroleum. These are, in fact, argillaceous rocks intermixed with a portion of organic matter allied to peat or lignite, which by heat is decomposed, and gives rise to oily hydrocarbons. These inflammable or lignitic shales, which may be conveniently distinguished by the name of *Pyroschists* (the *brandschiefer* of the Germans), are to be carefully distinguished from rocks containing ready-formed bitumen; this being easily soluble in benzole or sulphur of carbon, can be readily dissolved from the rocks in which it occurs, while the pyroschists in question yield, like coal and lignite, little or nothing to these liquids.

It is the more necessary to insist upon the distinction between lignitic and bituminous rocks, inasmuch as some have been disposed to regard the former as the source of the bitumen found in Nature, which they conceive to have originated from a slow distillation of these matters. The result of a careful examination of the question has, however, led us to the conclusion that the formation of the one excludes more or less completely that of the other, and that bitumen has been generated under conditions different from those which have transformed organic matters into coal and lignite, and probably in deep-water deposits from which atmospheric oxygen was excluded. Thus, in the palæozoic strata of North America we find in the Utica and Hamilton formations highly inflammable pyroschists which contain no soluble bitumen, and the same is true to a certain extent of some limestones; while the Trenton and Corniferous limestones of the same series are impregnated with petroleum or mineral pitch, and, as we shall show, give rise to petroleum springs. The fact that intermediate porous strata of similar mineral characters are destitute of bitumen, shows that this material cannot have been derived from overlying or underlying beds,

but has been generated by the transformation of organic matters in the strata in which it is met with. This conclusion is in accordance with that arrived at by Mr. S. P. Wall in his recent investigations in Trinidad. He has shown that the asphalt of that island and of Venezuela belongs to strata of the tertiary formation (of upper miocene or lower pliocene age), which consist of limestones, sandstones, and shales, associated with beds of lignite. The bitumen is found not only in the famous pitch lake, but *in situ* where it is confined to particular strata which were originally shales, containing vegetable remains. These have undergone "a special mineralisation, producing a bituminous matter instead of coal or lignite. This operation is not attributable to heat, nor of the nature of a distillation, but is due to chemical reactions at the ordinary temperature, and under the normal conditions of climate." He also describes wood partially converted into bitumen, which last, when removed by solution, leaves a portion of woody tissue. (Proc. Geol. Soc. London, May, 1860.)

The sources of petroleum and mineral pitch in Europe and in Asia are for the most part, like those just named, confined to rocks of newer secondary and tertiary age, though they are not wanting in the palæozoie strata, which in Canada and the United States furnish such abundant supplies of petroleum. In the great palæozoie basin of North America, bitumen, either in a liquid or solid state, is found in the strata at several different horizons. The forms in which it now occurs depend in great measure upon the presence or absence of atmospheric oxygen, since by oxidation and volatilisation the naphtha or petroleum, as we have already explained, becomes slowly changed into asphalt or mineral pitch, which is solid at ordinary temperature. It would even appear that by a continuance of the same action the bitumen may lose its fusibility and solubility, and become converted into a coal-like matter. Thus, in the calciferous sandrock in New York a black substance, which has been called anthracite, occurs in cavities with crystals of bitter spar and quartz. It sometimes coats these crystals or the walls of the cavities, and at other times appears in the form of buttons or drops, evidently, according to Mr. Vanuxem, having been introduced into these cavities in a liquid state, and subsequently hardened as a layer above the crystals which have conformed to them, showing that this coal-like matter was once in a plastic state. It is very pulverulent, brittle, of a shining black, and, according to Vanuxem, yielded but little ash and 11½ per cent. of volatile matter, which he regarded as water (Vanuxem, Geology of New York, iii. 33). A similar material occurs in the Quebec group in Canada, the equivalent of the calciferous sandrock, and fills cavities and fissures in the limestones, sandstones, and even in the accompanying trap rocks, as at Quebec, Orleans Island, Point Levis, and at Acton, presenting mamillary surfaces, as noticed by Vanuxem, which evidently show that it has once been semi-fluid. This matter from the first two localities is completely infusible, and insoluble in benzol; it readily crumbles between the fingers, and gives a very black powder. When exposed to a high temperature it gives off abundance of inflammable strong-smelling vapours, which condense into a tarry oil, and leave a black residue, which when heated slowly burns away, leaving only a trace of ash. The volatile portion is equal to from 19·5 to 21·0 per cent. The mineral from the Acton copper mine is much harder and less friable, and approaches to anthracite in its characters. When heated it gives off watery vapour without any bituminous odour. Its loss by heat was 6·9 per cent., and the residue of ash was equal to 2·2 per cent.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On the So-called Fallacies and Impediments of the Colour-tests for Strychnia, by H. Letheby, *M.B., &c., Professor of Chemistry and Toxicology in the Medical College of the London Hospital.*

In the course of the last year or two a number of essays have been written on the influence of certain substances either in simulating or preventing the action of the nascent oxygentest for strychnia. Among the latter, morphia, tartar-emetic, common salt, sugar and gum have been spoken of as serious impediments to the colour-test. In truth, however, the only importance of those essays is the warning which they furnish to the unpractised operator of the dangers which he will incur in a bungling manipulation. To the practical toxicologist they are of no value except as indications of what mischief may be done to both science and justice by the meddlesome interference of an unskilful hand. The extraction of strychnia from organic mixtures ought to give the alkaloid in a sufficiently pure state to negative the possibility of the fallacies or hindrances above mentioned. Most, indeed, of the so-called impediments to the action of the colour-tests are either soluble in ether and chloroform, which is the solvent used for the alkaloid, or they are so slightly soluble as to give but little trouble in the subsequent part of the analysis; and when, as in the case of sugar, common salt, and morphia, they are dissolved to a slight extent, and are left with the strychnia in the etherial residue, it is easy to destroy them without touching the stability of the poison. A drop or two of concentrated sulphuric acid put upon the residue and exposed in a dry, warm place for about an hour, will completely destroy all impurity which is likely to be present with the alkaloid; and then the neutralisation of the acid with potash, and a second treatment with ether, will give the strychnia sufficiently pure for detection by most of the colour-tests. I say most of the colour-tests, for my experience has led me to abandon the red prussiate of potash and bichromate of potash as very uncertain agents in comparison with peroxide of manganese, peroxide of lead, or the galvanic battery. In testing for strychnia, therefore, only one precaution is necessary to guard against failure from fallacy or impediment, and that is the putting of a little concentrated sulphuric acid upon the alkaloid, and the letting it stand for a short time before the introduction of the nascent oxygen agent. By adopting this precaution the fallacy at once shows itself by the coloration of the acid without the peroxide, and the impediment is also destroyed and betrayed. One thing only (aniline), as far as is yet known, presents characters at all comparable to those of strychnia, and even this fallacy is guarded against by very simple precautions (*Vide* Chemical News, February 8, 1862, p. 71).

On Morphia, by John Horsley, *F.C.S.*

In addition to the nitro-prusside test for morphia already mentioned, I have to notice another peculiarity of morphia,—viz., the rapidity with which it reduces nitrate of silver. If one drop of solution of acetate or sulphate

of morphia (1 per cent. strength) be mixed with ten or fifteen drops of a solution of nitrate of silver (four grs. to the drachm), and agitated for a minute or so, a fine white crystalline precipitate of frosted silver shortly takes place, the liquor acquiring a slight yellow colour from the reaction of the liberated nitric acid upon the morphia, and on decantation or filtration and the addition of strong nitric acid the usual orange-red colour of morphia is developed. If a white porcelain dish, containing the nitrate of silver solution, be slightly warmed previous to adding the morphia, the reduction is almost instantaneous, and the vessel coated with a film of silver. I have not noticed a similar reaction with other alkaloids, so that this peculiarity entitles it to a place amongst the ordinary tests for morphia given in our toxicological works. I consider it quite as delicate and unexceptionable as iodic acid, which was generally considered the most sensitive test. Gallic and tannic acids need never lead to any confusion with morphia, as their reaction upon silver solutions is very different, an intense muddy-black or brownish-black colour being produced almost immediately, and a flocculent precipitate forms, which is not the case with morphia, to say nothing of the other characteristics by which they are readily distinguished.

INTERNATIONAL EXHIBITION.

Class IV.

(*Continued from page* 343, Vol. V.)

Animal and Vegetable Substances used in Manufactures.

Glue is an important article in this class, and the Exhibition contains several very good specimens. In Case 1020 Messrs. Young and Co. display strong and bright samples of all kinds, and size quite free from disagreeable odour. These are perhaps surpassed by the specimens exhibited by Messrs. Procter and Bevington (1004), who have contributed samples of the finer sorts used for satin wood and ivory work, as well as strong glues for tropical climates. All these specimens are remarkably clear and bright. Good commercial samples of various sorts of glue will also be found in Cases 973 and 975. Case 974, in addition to the glue, contains some very clear, bright-looking gelatine, which we passed over in our notice of that article.

Coloured gelatines for ornamental purposes are exhibited by Mr. Green in Case 983, the colours being exceedingly good and bright. These gelatines being largely used by confectioners for wrapping up sweetmeats, and therefore very likely to get into children's mouths, it is well to know that all the colouring matters used are perfectly innoxious.

Few branches of manufactures have in as many years assumed the importance and received the same development as that of india-rubber and gutta-percha. Within the memory of most middle-aged persons india-rubber was a curiosity, and its only use was to erase pencil marks, the general impression among school boys at the time being that it was obtained from the elephant's trunk. Gutta-percha then had not been heard of in this country. Now extensive factories in many parts of England and in Scotland, employing in the aggregate several thousands of hands, are working them up into materials so useful that many have become necessaries, and the prospect of a stoppage in the supply of either india-rubber or gutta-percha would create a panic. Considering the increasing number of applications which india-rubber is still receiving, it behoves manufacturers to look well to the sources of supply, which may also, perhaps, be susceptible of increase. A considerable amount of caoutchouc, or caoutchoucous matter, which might be available for the coarser materials, such as kamptulicon, is annually thrown away by wholesale druggists and others who make some vegetable liquors, such as liquor rhei, and, as we believe is sometimes done, extract of opium from Egyptian opium. The quantity, perhaps, is not very large, but it might be worth preserving.

The first place in this department of the Exhibition is due to Mr. Mackintosh, who may be called the father of india-rubber industry. In a grand case (1101) Messrs. Mackintosh and Co exhibit specimens of all their productions, including copies of the books Mr. Mackintosh has written about india-rubber. It is unnecessary to say that everything looks as good as it can be; but there does not appear to be any novelty calling for particular notice. Mr. Hancock, as the inventor of vulcanised india-rubber, deserves the next mention. In his case (1079) will be seen all kinds of productions in vulcanised rubber, which appear fully to justify Mr. Hancock's position in the trade. In the case of the North British Rubber Company (1109) will be seen many articles in the material, which for neatness and finish have never been excelled. The overshoes, for example, greatly surpass in lightness and appearance any of the American importations we have seen. Close by (1121), the Scottish Vulcanite Company exhibit numerous applications of the material of Mr. Goodyear's invention,—vulcanite, or ebonite. This material has not yet received all the applications of which it is susceptible; but there are many elegant and useful articles in this case, one of whose great recommendations is their indestructibility. In 1146 Messrs. Warne and Co. show some novel and important applications of this substance. They have succeeded in uniting in one piece the soft ordinary vulcanised rubber and the hard indestructible vulcanite, and adapting the "junction rubber" —as they call it—for valves, pump-buckets, hydraulic ram rings, and many other purposes. These valves and buckets must necessarily have much greater durability than those made of ordinary vulcanised rubber alone. There are many other things, of more interest perhaps to engineers than chemists, but there is a ferruginous cement packing which deserves a notice, and which may be useful to some of our manufacturing readers. For all permanent joints, the inventors say that this material (elastic before its application) can be made to set as hard as iron, and it will expand and contract in the same ratio as the metal; while for other joints it can be made sufficiently elastic to answer all the purposes of india-rubber or other packing. There are exhibited, also, the ingenious applications of mineralised india-rubber to flesh and clothes brushes, with which most of our readers are familiar. Altogether, this case, which is placed in a situation where it is very likely to be passed without notice, must be considered the most interesting in this department of the Exhibition. In 1125 Messrs. Silver and Co. have likewise a good display of articles in vulcanised rubber and ebonite; and in 1059 Messrs. Cow exhibit a collection of useful articles of their well-known excellence of manufacture.

Gutta-percha may be seen in the class in all conditions, from the raw material as imported, to the completely purified article of Dr. Cattell, 914. This latter is a beautiful article, and we fear it is too good to receive many applications; but the Doctor deserves great praise for bringing its production to such a state of perfection.

In 1078 the Gutta Percha Company exhibit most of the useful articles they make, such as bottles, cells, and troughs for batteries and photographic baths. These are too well known to require any notice. Mr. Hancock's grand ornamental applications of gutta-percha to a large oak sideboard will be sure to attract the attention of the visitor, and will also receive his commendation.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures on Some of the Chemical Arts, with Reference to their Progress between the Two Great Exhibitions of 1851 and 1862, by Dr. LYON PLAYFAIR, *C.B., F.R.S., Professor of Chemistry in the University of Edinburgh.*

LECTURE IV. (*Thursday, May 29, 1862.*)

Calico-Printing.—The New Styles and Processes lately introduced, such as Archil Colours, Albuminous Mordants, Topical Colours, Guano Colours, Tar Colours, &c.

IN the lectures which I have had the honour of delivering before you, I have pointed out that the various colouring matters which are obtained from tar products and other substances readily attach themselves to wool and silk, but that they do not attach themselves with any readiness to the fibre of cotton unless we apply artificial means, which generally consists in the precipitation of certain oxides, called mordants, within the pores of the cotton, and which unite with the colouring matter, and so produce a tinctorial effect.

It is necessary for understanding to-day's lecture that you should know a little of the mechanical structure of cotton. When you examine a piece of cotton cloth or cotton fibre with a microscope, it is seen that it consists of a large number of small tubes, extremely small in diameter, but in most cases hollow and permeable to water, and not closed at the ends. Now, when cotton is dipped into any coloured liquid such as that [referring to a coloured solution on the lecture-table], it absorbs by capillary attraction a colouring matter into these small tubes; but if it is then put into water, the water displaces the coloured solution; and the cotton fibre itself, having no affinity for the colouring matter, and not uniting with it, parts with the colour which has been drawn up into these tubes, and the cotton is no longer coloured. It is, therefore, by inserting a mordant, such as I explained to you in my last lecture, that we endeavour to obtain an insoluble substance within the tubes,—a substance which has an affinity for the colouring matter, and which will form with it an insoluble compound or lake within the pores of the tubes.

As it is necessary to understand this, allow me again to show you one of these elementary experiments upon the subject. I have here upon this cotton an insoluble oxide of lead; it was put upon the cotton, as all these mordants are, not in an insoluble, but in a soluble form, and it was rendered insoluble by a chemical artifice—by taking away the acid by means of an alkali, and so depositing the insoluble oxide, as a mordant, within the pores of the cotton. Now, if I dip this into a solution which will form an insoluble precipitate within the pores, it is very easy for me to obtain a tinctorial effect; for instance, I dip it into chromate of potash, the acid of which has a desire to unite with the oxide of lead, and you see it becomes dyed yellow. Now, I have no apprehension of this yellow being washed out, because the mordant, or the substance that attracted the colour in the first instance, was insoluble in itself, and the coloured substance is insoluble also. It, therefore, remains in the pores of the cloth without any fear of its being washed out. But it is possible to alter the effect and to produce other colours upon an insoluble substance, if we so operate that this insoluble colour produced in the cloth has no chance of again getting into a soluble state. Thus, if I take this substance which I have dyed, and now dip it into a solution of lime, you will see that it becomes changed in its aspect; it becomes converted from the yellow into an orange, because we have altered the constitution of the salt, and have produced another compound upon it; and you see now, instead of bright yellow, an orange stain on the cloth, the mordant still having been kept insoluble in all these operations. In this case I took away a portion of the acid, increased, therefore, the proportion of base, and obtained another colour. This, also, is quite permanent, because it is in an insoluble state in the cloth.

Now, I will still make one or two elementary experiments to get this thoroughly into your mind, because it relates to the progress of the art of calico-printing within the last few years. I have here the means,—and it is an extremely beautiful experiment,—of producing these cheap and ordinary blue dresses, of which various samples are there exhibited [pointing to patterns on the table]. They are the cheapest kind of calico dresses which are produced, but they are obtained in a most scientific way, and in a manner which illustrates our subject completely. Indigo blue is insoluble in itself; it would not, therefore, do to attach to the cloth: it would not get within the pores. You must have it soluble to enter into the pores of the cloth—these little tubes which act by capillary attraction. Now, it is possible to add one atom of hydrogen by a chemical process, which I will not enter into here; and by adding one atom of hydrogen to indigo blue, it becomes what is called "indigo white." This indigo white has a great desire to unite with the oxygen of the air, and form water. I have here some calico which has nothing upon it, and at the same time you see I have figures, which figures are printed with sulphate of copper. Now, this is what I want you to observe,—the sulphate of copper. When the oxygen of the oxide of copper comes in contact with the indigo, it takes away the atom of hydrogen which renders it soluble; it converts that hydrogen into water, and rendering the blue insoluble will prevent it entering into the pores of the cloth. But where there is not that sulphate of copper on the rest of the pores of the cloth, the pores will absorb the indigo; it will come out a dirty yellow colour, which, being hung in the air, and losing its hydrogen, becomes of this blue colour. I render the indigo insoluble within the pores of the cotton cloth—within these tubes of which the cotton cloth consists. By rendering it insoluble it will be rendered a fixed dye, whilst this part which was protected by the sulphate of copper, parting with its oxygen very easily, and giving that oxygen over to the indigo as it was immersed, and preventing it getting into a soluble state within the tubes, remains white. We will allow this to remain in for a few minutes, in order to saturate the cloth, before we show the experiment.

I should not fulfil the promise of to-day's lecture, which is to draw your attention to the practical discoveries since 1851, were I to pass into the immediate subject of the new mordant,—the animal mordants, which have been applied,—without drawing your attention, also, to a few improvements which have recently been made in the preparation of that ordinary madder-dyeing which I formally drew your attention to as being the great means by which colouring matter is placed upon the cloth, until the tar-colours or aniline colours were discovered, and still is the great means, although it may be gradually dying out.

I told you, in the last lecture, that madder contained a large number of colouring materials, of which there are specimens here, but that, of these, alizarine is the most important one. Now, this alizarine in madder is not always in a free state; it is in a state analogous to what chemists call a glucoside,—that is to say, it is probably

united with grape sugar in the madder. In the state in which it is united with grape sugar in the madder—in the state of glucoside—it will not give any tinctorial effect; and, recently, it has been discovered that this condition can be broken up by simply moistening the madder with dilute sulphuric acid; and this body, glucoside,—or rubian, as it is called,—is broken up, while the gum or pectic acid which is contained in madder is at the same time rendered soluble, and can be washed away. The substance thus obtained is called "garancine." This fact was known before 1851, but its application has become more general since that time. This powdered madder contains only one-half the alizarine in it, in a state in which it can be used for dyeing. Calico-printers used madder, and after it ceased to give any tinctorial effect threw the rest away—tumbled it into the streams of the neighbourhood, or made it into a high heap, where it fermented and became a very disagreeable neighbour. They have now found that they have been throwing away one-half of the madder without making use of it. This residue may be treated with sulphuric acid, and it then forms what is called "garanceux" in the arts.

There is also one other important discovery in the arts which has been lately made, and that is the formation of what is called "commercial alizarine." That is not the right term for it. It is a garancine, made in the same way, with sulphuric acid, and which, when still moist, is exposed to the action of steam at a high temperature, under several atmospheres; and this steam being driven through, breaks up the glucoside which was still remaining, and destroys the pectic acid and the resin which exist in the madder, and which—as you will recollect I explained when speaking of madder dye in the last lecture—gave us an unpleasant compound which we were obliged to clear with soap; but it is found that by blowing superheated steam through madder the residue gives a pure colour, such as those, at one operation. They require scarcely any soaping in order to finish them; and, therefore, this saves a quantity of madder by preventing the necessity for the over-dyeing, which was necessary to withstand the scouring properties of the soap. A purer colour is also obtained at the same time.

There is only one other discovery since 1851 in connection with this matter, and that is what is called "flowers of madder." This is obtained simply by the fermentation of madder, which destroys the glucoside, rendering several of the impurities soluble, so that they may be washed out, while at the same time it liberates the alizarine just as was done in the other case.

I am glad that I can pass away from this madder-dyeing to the very curious applications in the arts which have been made in other directions; but, before I come to these, we will now lift out this cloth which we placed in the indigo solution, and see what is the result. Here, as I lift it out, you will observe that it is not blue, but that it is yellow. The only real blue parts which are more strikingly blue than the rest, are where the sulphate of copper has prevented the indigo reaching the interior. Now, we must hang this up in the air to allow the oxygen to act upon the hydrogen which is contained in the indigo white; and then it will become blue like that, and become insoluble within the pores of the cloth and fixed, or to save time, I may make it blue at once by immersing it in perchloride of iron.

In addition to this madder-dyeing there have been introduced lately, within the last few years, some colours which have become extremely popular. You will recollect a few years ago the mauve colour was introduced. It was not then made from the gas-tar, as it is at present. The first mauve colour that was so admired was made from archil. It was made from a certain kind of these ordinary lichens, which abound so abundantly as a weed. These lichens do not have any colouring matter within themselves; they contain a chemical substance, into the nature of which I need not enter, which is quite colourless and crystalline; but when that chemical substance is exposed to the action of ammoniacal liquids, or to the air in the presence of any alkali, it changes from being a colourless substance to a blue material, such as you see here. The knowledge of this fact was not new to chemists, but what is new is that within the last few years—about three or four years ago—they discovered a method of making these beautiful colours, got by the oxidation of lichens in the presence of ammoniacal liquids, permanent and fixed so that they resist the action of light and of air to a great degree, and give these beautiful mauve colours which we have all so much admired. The mode in which this was done was this: this colourless body does not colour by itself, but is capable of producing a colour. It is soluble in lime. They now take these lichens and treat them with lime, which dissolves this colourless body out, and then they add hydrochloric acid, which precipitates it in an insoluble white state. It is now taken and dissolved in ammonia; this ammoniacal liquor is exposed for several weeks to the temperature of 150°, and gradually it becomes, by the assimilation of ammonia and the absorption of oxygen, of this beautiful purple colour. To this ammoniacal liquor is now added chloride of calcium. This chloride of calcium unites with it, and produces an insoluble lime lake, just like this lake, which you see here, which is an alumina lake; but here the lime has gone down. In this way there is produced from these lichens a purple lake which is called French lake.

When we want to dye with this French lake, we must get rid of the lime, and therefore we boil it up with a solution of oxalic acids, a substance which I showed in the last lecture was prepared from sawdust. By boiling it with this acid oxalate of lime is produced, and then we get a coloured liquid, of which we have various samples here on the table. I have here some of this liquid already boiled up with oxalic acid, and filtered from the oxalate of lime to obtain it for our purpose. I will now add it to some water, and then sufficient ammonia to neutralise the oxalic acid which it contains. As too much ammonia should not be added, therefore I must test it with a test-paper, to see how much ammonia has been added, so that we do not exceed it in too large a quantity. There is now quite enough, and if we now place into it either wool or silk you will see its dyeing effect. Here is a hank of wool, and we rinse it in the solution. After a little time this wool will take up completely the colour, and will become dyed of that beautiful colour, with which I rather say we *were* familiar, than that we *are* familiar now, because, although now the colour which is used is the same shade as that previously produced, it is now made from coal-tar instead of from archil, on account of its being much more easily prepared, and being cheaper. This archil dye was introduced in 1856, and was extensively employed at first for dyeing wools and silk. There you see some skeins of silk with which we can readily dye; we have sufficient here to form a dye-bath. You see that the silk readily attracts the colouring material, and becomes a mauve colour, such as we have got upon our wool.

I now come to an interesting part of the subject. If you recollect what you have seen in our dyeing experiments, you will know that whenever we attempted to produce a dye without the use of a mordant, we always employed silk or woollen; you never saw me attempt to produce the colour on cotton without the use of a mordant; and the reason for that is this, that wool first, and then silk, have a great substantive attraction for colours. They themselves act as mordants, and extract the colours, and unite with them, and render them insoluble,—that is to say, the substances of animal origin have a positive attraction for the colour, just as a mordant has, and renders them insoluble in their own structure. Now, we could not apply these archil colours to cotton,

any more than we could not apply the aniline colours—those derived from coal-tar—to cotton, without a device which is of an interesting nature, and which I now proceed to describe.

The attraction of animal substances for colour is not confined to wool and silk; it is shared by many animal substances, as by the white of an egg, by cheese, by the gluten of wheat, too, and by a large variety of animal substances. Here I have got a hard-boiled egg and a little Magenta; and I put my hard-boiled egg into the Magenta and also into archil, only I must add a little ammonia to the latter. In a little time you will find that the white of the egg attracts the colour, and that the egg becomes dyed. We have not got enough Magenta here; we must add a little more; and you will find the colour soon attaches itself to the egg, and that the egg becomes dyed, and in this way you see it gradually takes on the dye colour, and after remaining there a minute or two, it will take it on very readily. Now, is it possible to use the white of an egg for the purpose of obtaining colours upon calico? This has been done recently with very great success. You only require to print the pattern with albumen,—the white of an egg in its ordinary state before it is coagulated. In this case of the hard-boiled egg, it has been coagulated by boiling; but you only require to print it before it is coagulated upon the cloth, as we have done in various instances exhibited upon the table. I have printed albumen upon the cloth in stripes, and now I expose this to the action of steam. Having printed it either in stripes or some other form on the cloth, it is then exposed to the action of steam, which coagulates the albumen and converts it into the same state as it is in the white of this boiled egg. I have here some calico printed with albumen which is not coagulated, and if I put this into water it would wash off from the calico, and I should have no result. But if I now coagulate this in the same way by heat, just as the white of an egg is coagulated in boiling, the albumen, which has already penetrated the pores of the cotton, gets into an insoluble condition, so that it can be used as a mordant for dyeing. I have here a little shelf on which I will place the calico, and now pass steam through the vessel, and the steam boils the albumen and converts it into the insoluble condition in which you see it in the boiled egg. You see this boiled egg has attracted the colour from the dye-stuff, and if, instead of using an egg, we use the white of an egg which has been coagulated, and then put the cotton into the Magenta, or archil, or mauve, we attract the colour into that place where the albumen is, while the rest of the material does not take on the colour.

Now, that that is the case I would like to show you by another simple experiment. For a long time after this interesting application of albumen was discovered, it was customary to dye with it as you have seen me do here. I first put albumen upon the cloth, and then I place it in the colouring matter, and it will attract the colour just as this egg has done; but that was a clumsy method. In all practical discoveries in the arts, as in science, we generally take the clumsiest and most roundabout method at first, and gradually come to simple methods. After a little while calico-printers saw that they were wasting a great deal of material by this process, and that they could obtain the same result by mixing a quantity of the archil, or the Magenta, or the mauve along with the albumen. They only required, instead of putting the cloth into the dye-bath, to mix the colour with the albumen. They printed them on in this state, and then they steamed them together. In the process of steaming, both the colour and the albumen got into an insoluble state within the pores of the cloth, and became permanent. Now, I want to show you this by an interesting experiment. Here I have printed the mixture of the colour and albumen on the cloth, but not steamed it. Here [exhibiting another fabric] is a fabric where I have the colour and albumen mixed, and have steamed it. I think they will suit our purpose. Now, I want to show you that if I take a portion which has been steamed and that portion which has not been steamed, very different results will take place when they are washed. I now place them both in soap and water, and now rub them a little together, but not too hard, because both of them are merely topical applications. You see the water is getting coloured already, and we can soon find out which is the steamed one and which has not been steamed, because one has got the albumen coagulated upon it, and the other has not, and parts with the colour. If this water were hot enough, it would coagulate the other. You readily see where it has not been steamed; the colour has almost all gone out, because there was no fixing or rendering insoluble of the colouring matter in these little tubes; whereas, that which had been steamed beforehand and rendered insoluble is, as you see, scarcely affected.

Now, I go a step further. It is not albumen alone which answers as a mordant for this purpose; it is any of those substances which physiologists call "histogenetic substances," that is to say, bodies which are capable of building up the framework of the body. In almost all food we have two classes of materials—substances which are capable of supporting our animal heat, and other substances which are capable of building up the framework of which we consist. Now, these are indifferently found in animals or vegetables, and it is no matter whether albumen is used for this purpose, or cheese made from milk, or gluten from wheat-flour, or you may take caseine, whether obtained from milk as in cheese, or from peas or beans. Here, for instance, is a solution of peas, and I add to it hydrochloric acid, and in a very little while you will find a curd go down, which curd is caseine, the same substance which I get from milk. When acid is added to the milk, the same curd will go down, caseine being present in both these substances. Now, if we use these albuminous materials it is a matter of very little consequence whence they are derived, and hence calico-printers use probably a much larger quantity of cheese under the name of "lactarine," for the purpose of fixing these colours, than they employ of the white of egg or albumen. The albumen is sometimes made from serum or the watery portion of blood. If caseine be dissolved in twice the quantity of alkali necessary for its solution, it coagulates like albumen, and can be employed in the same way. I may have told an unwelcome truth to the ladies present in stating that the beautiful dresses which they wear have their colours stuck on by cheese, but I must also inform them that the cheese has to be very carefully purified. Much of the skimmed-milk cheese of Scotland and Holland is largely employed by calico-printers; but it is made free from butter and substances which resist the colour, and is thus purified before being applied.

I must pass to another portion of my subject, and that is to the application of topical or pigment colours. Topical colours are colours employed which are themselves in an insoluble state, and their fixation is quite a peculiar and new art which has been introduced into calico printing. There are a number of beautiful pigments which all are desirous to apply; but how are we to apply them to cloth, as, for instance, in the case which I have before me. This green is an insoluble pigment. It is the same that the sign-boards of brewers are so often painted with. It is a mixture of arsenic and of copper—Scheele's green—to which I shall afterwards allude. Here is also another very beautiful substance, "ultramarine," which we should like to apply; but it is completely insoluble, and is a mineral; it is *lapis lazuli*, and the question is, how can we take this insoluble mineral substance and cause it to fix itself to the cloth? Again, I must call your attention to the histogenetic substances, or the albuminous group: albumen, caseine, fibrine, and the substances analogous to them, always exist in two forms; in one state they are soluble, in the other state

they are insoluble; as, for instance, if we examine freshly-drawn blood we find that the fibrine there is soluble, but in a few minutes the blood clots and produces an insoluble fibrine. The albumen of the egg is soluble; when it is coagulated it is insoluble in water. The caseine of peas is soluble, but it forms an abundance of insoluble curd by the action of hydrochloric acid, so that all these substances exist in a soluble and insoluble condition. Now, upon this property an application of topical colours has been made. You take the insoluble pigment which you desire to employ as a topical colour, and you mix it with some of those soluble histogenetic substances which are capable of being applied to the purpose, and print the mixture upon the cloth. You make, for instance, a mixture of that ultramarine with albumen, and print it upon the cloth. It is not likely that the fine parts of the pigment are capable of being drawn up in suspension with the albumen within the tubes of the cloth; but if they are not drawn into the pores of the cloth they are entangled by the albumen upon the outside of the cloth. Here we have mixed some ultramarine with albumen, and printed it upon the cloth, and then, by exposing it to the action of steam, as the other samples have been, the albumen coagulates either within the tubes, if the mixture has been fine enough to enter within the pores, or outside the tubes upon the walls, if it has been too coarse to enter them.

I have gone a little too fast I see in my description, because I ought to mention to you that before this method was attempted calico-printers tried the process of painting upon the cloth exactly upon the same principle as an artist paints. They mixed the pigment with varnish, and they applied the varnish to the cloth with the pigment in it. The most successful varnish was a solution of india-rubber—a solution of caoutchouc with naphtha. The naphtha was afterwards driven off by heat, and the india-rubber, which contained the colour, remained behind. But this process was dangerous. The vapour of the naphtha took fire sometimes and produced serious explosions, and then came the plan, which I put a little out of date, of mixing the colour with lactarine, that is, the curd of cheese, and then coagulating it by heat.

The applications of this process are numerous; for instance, here are the various shades of ultramarine and green pigments employed exactly in the way I have described to you by mixing them with the histogenetic substances, and then steaming them. You see what a great difference exists between the steamed and the unsteamed portion. Here it is before it has been steamed, and there it is after the process of steaming. This ultramarine is largely used for that purpose, and produces those beautiful blues which are now so extensively employed—ultramarine blues. They are merely topical applications, and stuck on by cheese, or by the white of egg, or albumen from blood. This substance—ultramarine—has of late years become of extensive application. It is one of the circumstances upon which the chemist likes to dwell as a triumph of his art. A few years ago this ultramarine was made exclusively from *lapis lazuli*, and it defied the art of the chemist to make it synthetically or by experiment. He analysed it over and over again, and found it to consist only of soda, clay, sulphur, and iron. It was an expensive substance, and he determined to unite these substances—clay, sulphur, and iron—and so form an artificial ultramarine. At last his efforts were crowned with success, and he now obtains this colour quite as beautiful as Nature offers it in the *lapis lazuli* itself, and for a few pence a pound, so that its application has now become very extensive.

We can look with admiration upon this art of applying pigments to cloth when such innocent substances as ultramarine are employed for the purpose of producing the colours desired; but when we see those greens which are produced from arsenic and copper our admiration of the art vanishes altogether. These substances are extremely poisonous,—poisonous to the persons who wear them, and poisonous far more to the persons who make them for the wearer. Those poisonous colours that are applied by topical fixing are merely put on by a sort of glue upon the surface of the cloth. They are stuck on, in fact, by cheese, and if by any friction a portion of them rubs off they form a fine dust, which floats in the air, and is readily breathed into the lungs. To give you some idea of the poisonous properties of this substance, I may mention that a lady in the extensive folds of a modern dress made of green tarlatan wears as much arsenic as would poison a hundred and fifty stalwart men. In addition to this, the colour is often put on with much less firm substances than those I have described to you. I have been describing the genuine way of applying it by means of lactarine or albumen, but in order to produce these green dresses very cheaply this poisonous pigment is often put on only with starch, and it then rubs off with the greatest freedom. You have lately seen accounts of Coroner's inquests held in this town upon poor flower-girls who have been poisoned by this colour in the making of green flowers. The amount used for that purpose is large. An lady's ordinary wreath of green flowers contains as much arsenic as would poison five men, so that the amount used of these poisonous materials is very great. It is a serious question, and I hope that you will see that I am not dwelling upon it too long. I am desirous to prevent persons using such poisonous materials. I may mention to you what Napier says in his "Manual of Dyeing." He says that he has known workpeople become invalids for life by having to wind as many yards of arsenic sage yarn—that is to say, yarn dyed green with this poison—as gave them in wages only one shilling. We must not avoid a solemn truth for fear of a pun when we allege that this is not the art of *dyeing*, but of *death*. If purchasers will avoid these fatal pigments, manufacturers will soon abandon their preparation.

I now pass on to another application, and a very curious one,—that is to say, to the application of guano colours for the purposes of dyeing. These guano colours were three years ago highly popular, but in consequence of so many changes of fashion, they are not so now. Still, they are extremely beautiful, and they received a number of applications. There are some of them there. Those guano colours are interesting on account of the source from which they are derived. You know that guano appears a very unpromising source from which to obtain these colours. The ordinary guano, Peruvian guano, is obtained in the rainless regions of South America, and consists of the exuvia of sea-birds and of their remains after they are dead. It is imported largely into this country as a manure, and it contains within itself this substance which is called uric acid, and it is from this that the colouring material is obtained. I will just show you this in order to explain more clearly the nature of the substance. If I act upon the uric acid with nitric acid, I produce two substances which chemists term "alloxan" and "alloxantine," of which I have small portions in this bottle. Now we will dissolve this in water; it must be boiling, and when it is boiling I pour it into a solution of carbonate of ammonia, and it forms what chemists call "murexide," which is a beautiful purple substance, rivalling the old Tyrian purple. The ammonia enters into its constitution and changes its nature, so that the two colourless substances produce a coloured material, which is now extensively employed in the arts. Now, you see as I pour these two colourless solutions together what a beautiful purple substance I obtain. This purple substance is, then, what chemists call "murexide," and which produces a substance used in dyeing. As soon as it cools a little we will filter it, and you will see that it will be a material like a Spanish fly. Now let me follow this out a little. As the guano is treated with hydrochloric acid the acid dissolves the earthy materials out of it, and the fixed salts; it is then treated with soda

which dissolves out the uric acid which is its prominent constituent. This uric acid is then treated with nitric acid, and it is changed into these two substances,—alloxan and alloxantine. It is then treated with carbonate of ammonia, and it becomes a substance which I have here,—murexide. If we wish to dye with this material, all that is necessary is to unite it with the cloth by means of a mordant, for which it has an affinity. This mordant may consist of lead, and then we obtain this beautiful purple colour. Where I have taken the nitrate of lead and placed it upon the cloth, and then dyed it in a solution of this purple murexide, we obtain a colour like that. If it is acted upon by ammonia and brightened up by a corrosive sublimate, we obtain this mauve colour, which a short time ago was extremely esteemed; so that from this unpromising manure, guano, are produced these beautiful colours. Here are some of them with lead; here are some of them with mercury; and here are the coloured precipitates produced, such as those fixed upon cloth.

The application of this guano created quite a new branch of colour-printing a few years ago, and it has only disappeared on account of similar colours of still greater beauty being produced from the products of tar. The Tyrians of old produced a purple in a manner which is not yet thoroughly understood. The general belief is that they obtained it from a kind of shell-fish, and that these shell-fish contained it in a little sac situated in their throat. Each of them yielded only one drop of this famous colouring material, which was, therefore, a most costly dye. In the time of Augustus a pound of wool dyed with Tyrian purple sold for 30*l.* sterling. The effect of these recent applications of the archil colours, guano colours, and those colours which we have described more fully in a former lecture as being derived from coal-tar, is, that we now obtain purple as fine as the Tyrian, and certainly far more economical.

The substance from which these are obtained have all been considered as waste materials; but by being applied as they have been of late years they give us these beautiful colours, which have rendered the art of calico printing extremely elegant in its results. But there is one thing which we have, perhaps, to deplore, and it is this,—that this beautiful art of calico-printing, which embraces so many elegant applications, is likely to be entirely altered, and, possibly, to disappear altogether in its present form, on account of those very discoveries. They have much effected, and will still more effect the use of dyeing materials from vegetable substances, such as madder, and which are employed with a great amount of skill. In those operations which are carried out in the process of dyeing,—bleaching, ageing, mordants, dunging, and cleansing, chemistry has been called upon to exercise itself. Far better colours than were formerly in use are now obtained from the coal-tar products with an ease which renders the science of a very secondary character, and the mode in which they are applied, by means of albumen and simple coagulation, removes the science of calico printing away from the chemist, and brings it more within the region of the mechanist, for it is according to his success in applying those colours in the most convenient way that the art is likely to be carried on in future. In the progress of this art there may be new applications of science in a direction which we do not expect; at all events, we have this bright hope before us that, whereas, for a long time past, calico-printers have been dependent upon foreign countries, such as France, Holland, India, and Turkey for their dyeing materials, we have now from the large amount of coal-tar which is produced the raw material at our discretion for the preparation of these colours, and we are likely to export colours instead of being, as we have been, a colour-importing country, if we can go a step further with them, and make the colours faster than they are at present.

I must apologise to you for having only skimmed the surface of this subject. It was impossible in two lectures to give you more than an outline of a manufacture so extensive as that of calico printing. The title of "calico-printing," as I told you in the beginning, is a generic one, and embraces the printing of silk, wool, and linen, as well as calico, and of the various mixed fabrics of which these form parts. The high skill requisite to make a mixed substance such as wool and cotton take on a uniform and brilliant colour may readily be imagined, but it is impossible for me to enter into a field so extensive. I must rest satisfied if I have in any manner interested those previously unacquainted with the art, and convinced them how important are the resources of chemistry in administering to the comforts and luxuries of mankind. In the next lecture I propose to go on with the subject of waste materials, and to show you that from the most unpromising substances we may often produce the most elegant utilities.

CORRESPONDENCE.

Bluish Ammoniacal Fumes.

To the Editor of the Chemical News.

Sir,—I am rather surprised to find that my plain communication of a simple matter of fact should have excited sufficient attention to draw forth two letters in reply within a week of its publication, and I am still more surprised to find that any one should venture to contradict a statement which may be verified in five minutes by anybody who is able to make a very simple chemical experiment and observe it accurately. It is true that an anonymous letter-writer, if not hampered with conscience, can afford to make reckless assertions, and may contradict at random without risking any reputation, and therefore the writers above alluded to have acted prudently in concealing their names.

"F. C. S." says that he made several experiments, and failed altogether in obtaining bluish vapours. My only reply to this is, that I am quite satisfied from the contents of his letter that he has never been a pupil of mine, and therefore I am in no degree responsible for his failures. The oddest part of his letter is that where he describes the experiment by which he obtained so near an approximation to the bluish fumes, that he might have actually described them as such but for his previous laboratory experience. His mode of proceeding was precisely that which is best adapted for not obtaining any bluish vapours at all, and his mode of observing the result is precisely that which is best adapted for not seeing any such vapours if he had obtained them. He sets "a dish of ammonia and a dish of hydrochloric acid side by side." With this arrangement he will undoubtedly obtain the white vapours, for this experiment is precisely the same in its character as those which I referred to as producing the well-known white fumes,—viz., the laboratory experiment of testing for ammonia by bringing a glass rod to the mouth of a tube containing the suspected vapours. He only varies the form of the vessels, and it matters not whether the hydrochloric acid be spread out upon a dish or upon a glass rod, as the fumes in both cases will be given off in the same manner and have about the same density. Now, I stated most distinctly that "the primary condition determining this bluish colour is that the hydrochloric acid fumes shall be much diffused and spread over a large space," and it was because they are far too concentrated, as they issue from a solution contained in a dish, on a glass rod, or any other vessel or surface, that I directed that the experiment should be made by standing "at a distance of a yard or two from the ammonia and blowing the fumes from the mouth of a hydrochloric acid bottle towards the ammonia." By these means the small quantity coming from the mouth of a bottle is diffused over a space a yard or two in length and of a considerable breadth, and the condition of the fumes

drifted by the wind from the chimneys of the chemical works is pretty fairly imitated.

Having thus entirely neglected to observe the "primary" conditions of making the experiment, "F.C.S." goes on to simply reverse the conditions of observing it.

I stated, that in order to observe the colour of these fumes most unmistakeably, they should be "projected against a dark background." "F.C.S." therefore projects them against the brightest background he can find—viz., the blue sky, and lest the imperfect transparency of his laboratory windows should diminish the brightness of his background, he makes the experiment in the open air. Again, I said that the spectator should stand "with his back to the light," therefore "F.C.S." faces it point-blank. If anything further could be invented to render a successful experiment more completely impossible, it would be that the bright background should have a blue colour, for if my hypothesis concerning the cause of the bluish colour be correct—viz., that it is caused by the existence of minute transparent bluish crystals, it will be obvious to any one acquainted with the most rudimentary laws of chromatic optics, that such vapours must be rendered almost or even completely invisible when thus projected against a blue sky; for a perfectly transparent coloured body projected against a bright background of the same colour would be invisible, an imperfectly transparent body under the same conditions would be imperfectly visible, and a transparent body of a composite colour projected against a bright background of the colour of one of its primaries, would exhibit only the colour of its other component colour or colours. Thus the bluish vapours, the colour of which is compounded of blue and white, would, if seen against a blue sky, appear very faintly white if they were of a pure blue, the same as the sky itself, and quite transparent; they would not be visible as a distinct body, but would merely intensify the apparent colour of the sky at the part which they overlaid. I have before me at this moment a very simple and complete illustration of this. At about 150 yards from my study window is a house, behind which rises the upper part of an oak tree. Thin smoke is issuing from one of the chimneys of the house. The tree is in shadow, and the colour of the shade is an olive-brown; the smoke is projected partly against the tree and partly against the sky beyond the tree. That portion against the tree is bluish, that against the sky is whitish and barely visible, and the line separating the colours is precisely the outline of the tree.

"F.C.S." states that I am in error in regarding the bluish vapours as proofs of the presence of hydrochloric acid. If he will read my letter again, he will learn that I refer to many other sources of bluish vapours; and I am perfectly well aware that other acids, besides hydrochloric, will produce bluish vapours by coming in contact with ammonia, and it was on this account that I took the trouble to expose filtering paper to the fumes from the chimney, and then took it home and tested it for chlorides. If I had regarded the bluish fumes as "proofs of the presence of hydrochloric acid," this would have been superfluous labour, and it was in order that I might not be misunderstood to do so, that in my letter to you, devoted to the subject of the bluish fumes, I went aside from the main subject, and particularly referred to this precautionary and confirmatory experiment; but "F.C.S.," in reading as well as in manipulation, seems determined to go out of his way in order to go wrong. With his remarkable genius for blundering in every possible and conceivable way, it is very natural that "F.C.S." should come to the conclusion that "dense or attenuated, white it is and must be." He further says that, he "cannot imagine the vapour, from contact of the two gases, to look other than white." I would respectfully suggest to "F.C.S." that in such matters as this, he should not exercise his imagination at all, but simply observe accurately and record correctly.

I have thus fully replied to "F.C.S.;" but the communication of your other correspondent, who describes himself as "Blue Moonshine," is quite beyond my powers. He begins by hoping that it is all satisfactory, then telling that when he was a boy he saw something blue come from dunghills that were truly rural, and far from chemical works, and that were close by chemical works and not truly rural, and therefore it is all wrong and blue moonshine. As Mr. Moonshine's logic is as intangible as his substance, I can do nothing with it, but must helplessly submit to the full consequences of his terrible sarcasm.—I am, &c.

W. Mattieu Williams.

Hall Road, Handsworth, near Birmingham, June 25.

Detection of Lime in Flour.

To the Editor of the Chemical News.

Sir,—The detection of lime in flour has given rise to many different modes of testing, some long and tedious, others not very reliable. The one I am about to describe is not put forth as the only reliable one, but because it is easy of manipulation and very delicate.

Among the various tests for the detection of lime in bread or flour, is one lately issued by Mr. Timothy. He tells us "to take the water in which a loaf of bread has been boiled, and add to it oxalate of ammonia, which, upon the solution turning milky, indicates the presence of lime."

This mode of testing has two great disadvantages :—1st. The quantity of water used must necessarily be large, as the sulphate of lime or plaster of Paris, the usual adulterant, is only slightly soluble, requiring for solution 500 parts of cold and 450 parts of hot water. 2nd. Bread ought not to be taken, as it generally contains a portion from the fact that the water with which the flour is incorporated invariably contains lime in solution. Flour, therefore, ought always to be taken, unless the bread has been made with distilled water. Flour treated very similarly to the way Mr. Timothy recommends the bread to be done, gives very good results: digest the flour in water for two or three hours, then boil, filter, and evaporate down to one or two drachms; to this concentrated solution add ammonia and oxalate of ammonia. This is a tedious operation. The hydrochloric acid process also gives good indication of the presence of lime: ignite the flour, then boil the black residue with hydrochloric acid, filter and evaporate until it crystallises, then dissolve in water and add the usual tests. But with neither of these tests can the lime be determined quantitatively, as a portion, in the first case, is sure to escape solution; and in the second, to escape the action of the acid.

The following is the mode I usually follow, which I give *in extenso*. It depends upon the complete solution of sulphate of lime in nitric acid:—

Take twenty-five grains of the flour, and burn in a porcelain crucible, remove the black cinder and powder, ignite again for fifteen minutes; when cold boil the black powder thus obtained in nitric acid for a few minutes, when the lime is converted into nitrate. It seems that a portion of the black powder is oxidised by the acid, which itself is reduced to the state of nitric oxide, which in contact with the air is converted into red fumes of nitrous acid; when cold add a little water and filter; evaporate the filtrate with gentle heat to dryness. A crystalline deliquescent salt of nitrate of lime will be obtained, which is perfectly soluble in water, alcohol, and alcoholic ammonia; dissolve either in water or alcoholic ammonia. I prefer water,—the solution has a strong acid reaction; filter if necessary, then add ammonia to neutralise the acid, then oxalic acid, when a white flocculent precipitate is immediately produced, soluble in hydrochloric acid or nitric acid; wash the precipitate and treat it with acetic acid, filter, wash with warm water until free from acid. Heat the white precipitate of oxalate of lime thus obtained, in a glass tube sealed at one end, to redness, when the oxalate will be con-

verted into carbonate without any discernible discoloration, from which, by weighing, the quantity of lime present can be deduced. This last test is worthy of notice, inasmuch as it is easy of manipulation and exceedingly delicate, so much so that I have detected lime when only in the proportion of one grain to the 100 grains of flour.

I am, &c. R. J. Rutter,
Analytical Chemist.

Ipswich.

Mr. Horsley's New Test(?) for Strychnine and the Separation of Strychnine from Morphia.

To the Editor of the Chemical News.

Sir,—It is always with great unwillingness that I put aside the test-tube for a pen, but upon the present occasion I feel that there is a necessity, as a great error has been in circulation without contradiction for upwards of a fortnight. Some years ago, while engaged upon an extensive series of experiments upon strychnine, among other reagents, the nitro-prusside of sodium was tried by me, and put aside as valueless as a means of detecting that alkaloid. It was, therefore, with much surprise that I read Mr. Horsley's statements in your valuable Journal of the 21st ult. He has evidently fallen into a mistake by using something else for the nitro-prusside of sodium, probably the ferridcyanide of potassium, as the former reagent has no reaction whatever upon strychnine under the circumstances detailed.

With regard to the alleged difficulty of detecting strychnine in the presence of morphia, I will not occupy your valuable space further than is requisite to state that morphia is insoluble in benzol, and that strychnine is very soluble in that menstruum. Consequently, in any case where there is reason to suspect the presence of morphia, the operator has only to substitute benzol for ether or chloroform, and after charring any foreign organic matter by sulphuric acid (as published by Mr. Girdwood and myself in 1856), he will obtain a trustworthy and satisfactory result.—I am, &c.

J. E. D. Rodgers,
Formerly Lecturer on Chemistry at the St. George's School of Medicine.

41, Denbigh Street, Pimlico, July 1.

MISCELLANEOUS.

ON THE OCCURRENCE OF THE DIAMOND AND CHLORO-BROMIDE OF SILVER AMONG THE GOLD ORES OF AUSTRALIA.

We are indebted to the kindness of the Chemist of the War Department for some interesting particulars in reference to certain gems and ores which have been lately examined by Mr. George Foord, F.C.S., of Melbourne, and by him communicated to the *Argus*, Australian newspaper.

After referring to the fact that silver is always present in samples of gold ore, occurring in those of Australian origin in proportions varying between ·17 and 38·75 per cent., Mr. Foord goes on to say, "that since the working of the Victoria quartz lodes for gold, much of a lower fineness than the average of alluvial gold has come to hand, of which it may be generally stated that the causes which combine to determine this inferior quality of matrix gold are of a mixed character, such as the fineness of the gold itself as it exists in the matrix, the mode and skill of extraction, nature of associated minerals, &c. Among those samples, the low character of which would appear to be principally dependent on the nature of the minerals treated, may be mentioned certain bars of a pure white colour, and remarkable for their unusually large proportion of silver. In such cases, it is not easy in Melbourne to ascertain the exact locality of origin; but I will allude especially to a bar of silver-gold of 164½ ounces, brought from St. Arnauds to Melbourne by Messrs. Bennett and Co., of the former locality, in December last, and which yielded rather under 20 per cent. of gold and 80 per cent. of silver.

Bars of this quality had from the first raised in my mind the questions as to whether silver and gold existed in the matrix in the combined state of a white alloy, or whether in the lode in the separate states of native gold and silver, being brought together during the process of amalgamation; or, again, whether the silver existed in a mineralised state, as it does in the larger proportion of the silver ores of other countries.

To the Messrs. Bennett and Co. I am indebted for specimens, by means of which I have obtained in this instance a settlement of the question. From them I have obtained a small specimen of the matrix, and with it a small pulverized sample which they had concentrated by washing. From examinations of these I am enabled to announce that the silver exists in their mine in the same state as that of certain of the Chilian ores, namely, as chloro-bromide of silver. From a small sample of the concentrated mineral, I obtained 23·65 per cent. of silver, and 1·3 per cent. of gold. The specimen which I retain presents the aspect of a cavernous quartz matrix, with a ferruginous incrustation, which is studded over with very minute and brilliant crystals of the bromo-chloride. These are of a greenish yellow colour, and under the microscope afford evidence of an octohedral form. They have a compressible and sectile character, which may be compared to that of wax at a low temperature.

Of course, other varieties of this group of silver ores proper may exist in the same lode; and lower down in the workings, even the other classes of silver ores, native silver, sulphides, &c.; and as I am still in expectation of receiving from Messrs. Bennett further samples, I entertain hopes of being enabled by further investigation to decide these points.

The diamond from the Ovens District was of a transparent yellow colour, highly refractive, of a sub-adamantine lustre, and irregular crystalline form, the surface being composed of curved facets, mostly convex, and either three-sided or rhombic,—a form which leads Mr. Foord to the opinion that the stone is a modification of the rhombic dodecahedron. The edges are perfect, but many of the faces present a striated appearance, and a want of brilliancy, or what may be termed greyness. The specific gravity was found to be 3·5, or that of the diamond, and its hardness 10 degrees. It became electric by friction, but not by heat. The weight of the gem was 2·356 grains.

During the course of some experiments upon the combustion of the diamond, Mr. Foord observed a change in physical condition, which appears to indicate that the transparent variety may become transformed into graphitic carbon as the effect of sudden cooling from the state of intense ignition. Whilst burning a fragment of colourless diamond in oxygen gas, the ignited particle, being diminished in size, fell from the platinum holder on one occasion on to a glass plate forming the bottom of the jar, at another time into a capsule of water. In the first case the residual portion was merely rounded in form, and slightly opaque on the surface like a water-worn topaz; but in the latter experiment it became perfectly black and opaque, with a bronze-like superficial tarnish.

ANSWERS TO CORRESPONDENTS.

Self-Teacher.—You will not find a better book for your purpose than Abel and Bloxam's Handbook, published by Churchill.

X.Y.Z.—We cannot give the information so soon as you require it. Consult the work mentioned below.

J. Hamilton.—A letter addressed to the gentleman, at the Royal Dublin Society, Dublin, will find him. We do not think the colours are yet made for sale.

Books received.—"On the Recent Progress and Present Condition of Manufacturing Chemistry in the South Lancashire District," by Drs. E. Schunck, R. Angus Smith, and H. E. Roscoe. "A Dictionary of Calico-Printing and Dyeing," by Charles O'Neill. [We will notice this work at length in a subsequent Number.]

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Orthite from Swampscot, Massachusetts, by DAVID M. BALCH, *B.S.*

MORE than a year since, while examining the rocks at Swampscot Beach, near the Clifton House, Massachusetts, I observed a mineral occurring in small amorphous masses in quartz and red felspar, which immediately attracted my attention by its peculiar lustre and appearance; this, on examination, has proved to be orthite, almost identical with that from the Norway granite.

The shore at Swampscot, and for half a mile or so north-east towards Marblehead, consists of ledges of rock, against which the sea breaks, ranging from sienite to porphyry, and extending fifty or sixty feet backward, and, at the most, from fifteen to twenty feet in height, to the pasture land above; these rocks are very rugged, seamed with trap, veins of quartz, and red felspar; in the latter occur good specimens of fibrous epidote, and the mineral furnishing the subject for this paper.

The orthite is found almost always imbedded in quartz, but I have obtained a few pieces from the felspar, which forms the bulk of the veins; it occurs in black amorphous masses, sometimes surrounded with a reddish coating of sesquioxides of iron and cerium, when much exposed to the weather or the action of the sea; and in very small quantity, for I only obtained a few grammes in return for searching the rocks throughout their whole extent. I examined this mineral shortly after its discovery, sufficiently to determine its name and general composition, and more carefully again this winter, and give below an outline of the method of analysis and its results.

The orthite of this locality appears always to occur massive; at least no specimens that I have found show any signs of crystal faces.

Specific gravity at 18° C., 3·69—3·71. Lustre, resinous, and in some cases nearly vitreous. Colour, jet black, and streak grey. Heated in thin splinters before the blowpipe, it fuses slowly to a black blistered glass; dissolves readily in borax, and gives a globule, red when hot, but yellow after cooling; with soda it gives a slight manganese reaction; in its natural state is very easily decomposed by chlorhydric acid, but after ignition is not affected by it in the least.

A small portion being reduced to powder, dried at 110° C., and then ignited, lost 1·49 per cent. of combined water.

The preliminary analysis was performed on .445 grammes; from it I ascertained the composition of the mineral, but was unable to determine accurately the amount of those substances present in small quantity. My method of analysis was that given by Wöhler,* in which cerium, yttria, &c., are separated from iron and alumina by moist carbonate of baryta. The following results were obtained:—

Silica	32·62
Alumina } Ferric-oxide }	29·47
Ceric-oxide, &c.	24·74
Lime	8·05

Magnesia and soda were also present.

The ceric-oxide, &c., weighing about a decigramme, was examined for yttria, and abundant traces of it found; also inconsiderable traces of manganese.

The succeeding analyses, undertaken principally to ascertain the amount of yttria present, were conducted as follows:—A quantity of the levigated mineral, dried at 110° C., was decomposed in a porcelain dish by chlorhydric acid (sufficient nitric acid being added during the operation to peroxidise the iron), and the silicic acid separated as usual; the filtrate from the silica was then supersaturated with ammonia, by which oxides of iron, aluminium, cerium, and yttrium were thrown down, the magnesia being held in solution by the chloride of ammonium formed by the excess of chlorhydric acid present in the liquid; this precipitate, which I will designate by *a*, was completely washed by decantation and then on a filter, and the washings, evaporated to a small bulk, were mixed with the filtrate; from this the lime was thrown down by oxalate of ammonia, and weighed first as carbonate and then as sulphate; in the filtrate from the lime magnesia was precipitated by phosphate of soda, as I did not intend to determine the amount of soda or potassa which may have been present; manganese was also present in such small traces that it was disregarded.

In order to separate the ceric-oxide and yttria from sesquioxide of iron and alumina in precipitate *a*, I digested it, while still moist, in aqueous oxalic acid; the separation was perfect, and the insoluble oxalates obtained were free from iron; after standing twenty-four hours, these were well washed, dried, ignited, and weighed as ceric-oxide and yttria. The sesquioxide of iron and the alumina, contained as acid oxalates in the filtrate and washings of the above, were now separated; in the first case, as usual, by potassa; in the second analysis by evaporating to dryness, igniting to destroy oxalic acid and expel ammoniacal salts, peroxidising any reduced iron by nitric acid, and weighing the mixture of $Al_2O_3 + Fe_2O_3$ as a control to the first analysis.

These analyses were performed exactly alike, with the exception given above; the first on ·782 grammes, and the second on 1·032 grammes of substance.

To separate yttrium and cerium oxides, I employed the following process given in Rose's "Handbuch der Analytischen Chemie," Braunschweig, 1851, bd. ii. s. 72. The ceric-oxide, &c., from both analyses, weighing nearly five decigrammes, was fused with bisulphate of potassa, the mass digested with a warm solution of

* *Practische Uebungen in der Chemischen Analyse, Göttingen*, 1853, s. 112.

sulphate of potassa sufficiently concentrated to deposit crystals on cooling, and the insoluble sulphate of potassa and cerium entirely washed out with this solution; yttria was thrown down from the decanted liquid and filtrate by excess of potassa, and weighed as such; it contained a little manganese.

The following results were obtained by these analyses:

	A		*B*
Silica	33·31		32·94
Alumina	14·73	Al_2O_3 }	33·60
Ferrous oxide	15·82	Fe_2O_3 }	
Cerous oxide	21·94		20·71
Yttria	1·32		1·32
Lime	7·85		7·87
Magnesia	1·25		1·47
Soda		(undetermined)	
Water	1·49		1·49
	97·71		99·40

In orthite and allanite about half the iron is usually in the state of sesquioxide; in analysis *A*, all the iron is calculated as protoxide, which occasions the apparent loss; an attempt was made to determine the amount of protoxide present by the chloride of gold and sodium process,† but it was unsuccessful, and could not be repeated for want of material.

These analyses, and the physical properties of the mineral, prove it to be orthite, very closely resembling that from Hitteroe, Norway.‡

It is interesting to remark that this is the first instance of the occurrence of yttria in New England, if we except the single specimen of yttrocerite found some time since in Worcester County, Massachusetts, the locality of which is unknown. As our rocky New England ledges are more extensively examined or quarried, we have reason to hope that they may yield some of the other rare minerals of the Scandinavian granites.—*American Journal of Science.*

On the Presence of Xanthic Oxide in Guanos containing no Uric Acid, by Dr. T. L. Phipson, *F.C.S. Lond., Member of the Chemical Society of Paris, &c., &c.*

Some specimens of guano that have lately been forwarded to me for analysis, and which are known in commerce as "Jarvis Island Guano," "West India Phosphate," &c., have presented a peculiarity which renders them interesting. They contain no uric acid, or, at least, in some specimens only an exceedingly minute trace of uric acid, whilst a notable amount of xanthic oxide is present in them.

The want of uric acid explains why these kinds of guano only yield 0·46 per cent. of nitrogen, equal to about half a per cent. of ammonia, and are consequently very inferior in an agricultural point of view to pure Peruvian guano.

Xanthic oxide, $C_5H_2N_2O_2$, formerly discovered by Dr. Marcet in a small human calculus, was found in guano some years ago by M. Unger. In a sample of the variety of guano mentioned above I have extracted xanthic oxide in the following manner: The guano was mixed with a solution of caustic soda, boiled once or twice, and filtered. Through the filtered liquid a current of carbonic acid was passed for several hours, when all the xanthic oxide was precipitated as a white powder, exceedingly fine, and remaining for a long time suspended in the liquid. It can, however, be readily collected upon a filter. The following is the analysis of a sample of this kind of guano, in which not a trace of uric acid could be detected:—

Moisture	1·00
Xanthic oxide, $C_5H_2N_2O_2$	0·25
Brown organic matter	16·25
Phosphate of lime	35·50
Carbonate of lime	34·00
Sand	12·00
Chloride of sodium and loss	1·00
	100·00

Nitrogen 0·46 equal to ammonia 0·55 per cent.

The xanthic oxide extracted as above gave all the reactions indicated by Marcet and Berzelius.

† Rose's "Handbuch," bd. xi. s. 129.

‡ Dana's "Mineralogy," 1854, p. 210.

TECHNICAL CHEMISTRY.

On the History of Petroleum or Rock Oil. By T. Sterry Hunt, *M.A., F.R.S., of the Geological Survey of Canada.*

(*Continued from page* 6.)

An evidence of the presence of unaltered petroleum in almost all the Lower Silurian limestones is furnished by the bituminous odour which they generally exhibit when heated, struck, or dissolved in acids. In some cases petroleum is found filling cavities in these limestones, as at Rivière à la Rose (Montmorenci), where it flows in drops from a fossil coral of the birdseye limestone; and at Pakenham, where it fills the cavities of large orthoceratites in the Trenton. From some specimens nearly a pint of petroleum has been obtained. It is also said to occur in the township of Lancaster in the same formation. The presence of petroleum in the Lower Silurian rocks of New York is shown in the township of Guilderland, near Albany, where, according to Beck, considerable quantities of petroleum are collected upon the surface of a spring which rises through the Hudson River or Loraine shales. On the great Manitoulin Island, also, according to Mr. Murray, a petroleum spring issues from the Utica State, and he has described another at Albion Mills, near Hamilton, rising through the red shales of the Medina group; these have probably their origin in the Lower Silurian limestones, which may in some localities prove to be valuable sources of petroleum.

In the Upper Silurian and Devonian rocks bitumen is much more abundant. Eaton long since described petroleum as exuding from the Niagara limestone, and this formation throughout Monroe County, in western New York, is described by Mr. Hall as a granular crystalline dolomite, including small laminæ of bitumen, which give it a resinous lustre. When the stone is burned for lime the bitumen is sometimes so abundant as to flow like tar from the kiln. In the Corniferous limestone, at Black Rock, on the Niagara River, petroleum is described as occurring in cavities, generally in the cells of fossil corals, from which, when broken, it flows in considerable quantities. t also occurs in similar conditions in the Cliff limestone (Devonian) of Ohio.

Higher still in the series, at the base of the Hamilton group, occur what in New York have been called the Marcellus shales; these enclose septaria or concretionary nodules, which contain petroleum, while at the summit of the same group similar concretions, holding petroleum, are again met with. The sandstones of the Portage and

Chemung group, in New York, are in many places highly bituminous to the smell, and often contain cavities filled with petroleum, and in some places seams of indurated bitumen. A calcareous sandstone from this formation, at Laona, near Fredonia, in Chatauque County, contains more than two per cent. of bituminous matter. At Rockville, in Alleghany County, according to Mr. Hall, the same sandstones are highly bituminous, and give out a strong odour when handled, and in the counties of Erie, Seneca, and Catarragus, abundant oil springs rise from the sandstones, and have been known to the Seneca Indians from ancient times. In the northern part of Ohio, according to Dr. Newberry, petroleum is found to exude, in greater or less quantity, from these sandstones wherever they are exposed, and the oil wells of Pennsylvania and Ohio are sunk in these Devonian sandstones, often through the overlying carboniferous conglomerate, and in some cases apparently, according to Newberry, through the sandstones themselves, which are supposed by him to be only reservoirs in which the oil accumulates as it rises through fissures from a deeper source, in proof of which he mentions that, in boring wells near to each other, the most abundant flow of oil is met with at variable depths. In some instances the petroleum appears to filter slowly into the wells from the porous strata around, which are saturated with it, while at other times the bore seems to strike upon a fissure communicating with a reservoir which furnishes at once great volumes of oil. An interesting fact is mentioned in this connection by Mr. Hall. In the town of Freedom, Catarragus County, New York, is a spring which had long been known to furnish considerable quantities of petroleum. On making an excavation about six yards distant, to the depth of fourteen feet, a copious spring of petroleum arose, and for some time afforded large quantities of oil, after which the supply diminished in both the old and new springs, so that it is now less than at the first settlement of the country. Notwithstanding its general distribution throughout a considerable region in the adjacent portions of New York, Pennsylvania, and Ohio, it is only in a few districts that it has been found in quantities sufficient to be wrought with profit. The wells of Mecca in Trumbull County, Ohio, have been sunk from 30 to 200 feet in a sandstone which is saturated with oil; of 200 wells which have been bored, according to Dr. Newberry, a dozen or more are successfully wrought, and yield from five to twenty barrels a-day. The wells of Titusville, on Oil Creek, Pennsylvania, vary in depth from 70 to 300 feet, and the petroleum is met with throughout. The oil from different localities varies considerably in colour and thickness, and in its specific gravity, which ranges from 28° to 40° B. (from ·890 to ·830).

The Valley of the Little Kenawha, in Virginia, which is to be looked upon as an extension of the same oil-bearing region, contains petroleum springs, which, so long as 1836, according to Dr. Hildreth, yielded from fifty to a hundred barrels yearly. It here rises through the carboniferous strata, and, as elsewhere, is accompanied by great quantities of inflammable gas.

The black inflammable shales of the Devonian series in Western Canada, which were formerly referred to the Hamilton group, and are now considered to belong to the base of the overlying Portage and Chemung, appear at Kettle Point, on Lake Huron, and in portions of the region southward to Lake Erie; but the oil wells sunk in Enniskillen show that the source of the oil is really below the horizon of these shales, inasmuch as the underlying argillaceous shales and limestones of the Hamilton group are there found near the surface, and have been penetrated 120 feet, at which depth oil is still met with, leaving but little doubt that it is derived from the limestones beneath, which, both in New York and in Canada, are impregnated with petroleum. A somewhat slaty, brownish-black, bituminous dolomite, belonging to the Corniferous limestone from Pine Creek, near Alma, in Kincardine, gave me not less than 12·8 per cent. of bitumen, fusible and readily soluble in benzole, and another from the Grand Manitoulin Island, which was a brown, crystalline dolomite, yielded from 7·4 to 8·8 per cent. of similar bitumen. The solid form of this bitumen at the outcrop of the rocks is probably due to the action of the air.

The existence of liquid bitumen in the Corniferous limestone in Western Canada was pointed out as long ago as 1844 by Mr. Murray, who tells us that this rock is generally bituminous, and that cavities in it are often filled with petroleum; the quarries near Gravelly Bay, in Wainfleet, are cited as an example (Report of Geol. Survey, 1846, p. 87). In the report for 1850 we find a notice of what are called oil springs, in which petroleum rises to the surface of the water near the right bank of the Thames, in Mosa, and in two places on Bear Creek, in Enniskillen. Subsequently Mr. Murray described a considerable deposit of solid bitumen or mineral tar, which occurs in the same township, extending over about half an acre, and in some places two feet in thickness, doubtless formed by the drying up of petroleum springs (Report for 1851, p. 90). I had already, in the Report for 1849, p. 99, described this bitumen from specimens in the Museum of the Geological Survey, and called attention to its economic applications, remarking that "the consumption of this material in England and on the Continent for the construction of pavements, for paying the bottoms of ships, and for the manufacture of illuminating gas, is such that the existence of these deposits in the country is a matter of considerable importance." At this time solid bitumen was thus employed, but in the liquid form of petroleum its use was chiefly confined in Europe to medicinal purposes. Under the names of Seneca oil and Barbadoes tar it had long been known and employed medicinally by the native tribes of America. Its use for burning, as a source of light or heat, in modern times has been chiefly confined to Persia and other parts of Asia, although in former ages the wells of the island of Zante, described by Herodotus, furnished large quantities of it to the Grecian Archipelago, and Pliny and Dioscorides describe the petroleum of Agrigentum, in Sicily, which was used in lamps under the name of Sicilian oil. The value of the naphtha annually obtained from the springs at Bakoum, in Persia, on the Caspian sea, was some years ago estimated by Abich at about 600,000 dollars, and the petroleum wells of Rangoon, in Burmah, are said to furnish not less than 400,000 hogsheads yearly. In the last century the petroleum or naphtha obtained from springs in the Duchy of Parma was employed for lighting the streets of Genoa and Amiano; but the thickness, coarseness, and unpleasant odour of the petroleum from most sources were such that it had long fallen into disuse in Europe, when in 1847 the attention of Mr. Young, a manufacturing chemist of Glasgow, was called to the petroleum which had just been obtained in considerable quantities from a coal mine at Riddings, in Derbyshire, from which, by certain refining processes, he succeeded in preparing a good lubricating oil. This source, however, soon becoming exhausted, he turned his attention to the somewhat similar oils which Reichenbach and Selligue

had long before showed might be economically obtained by the distillation of coal, lignite, peat, and pyroschists. To this new industry Mr. Young gave a great impetus, and in connection with it attention was again turned to the refining of liquid and solid bitumens, it being found that the latter by distillation gave great quantities of oils identical with those from petroleum. About the year 1853 the attention of speculators was turned to the deposits of bitumen in Enniskillen just described, but it was not till 1857 that Mr. W. M. Williams, of Hamilton, with some associates, undertook the distillation of this tarry bitumen, when they soon found that by sinking wells in the clay beneath it was possible to obtain great quantities of the material in a fluid state. Large numbers of wells were subsequently sunk by Mr. Williams and others in the southern part of the township of Enniskillen, along the borders of Black Creek, and also about ten miles farther north on Bear Creek. Nearly 100 wells had been sunk when I visited the place in December last, and many more have since been bored. Of these but a small proportion furnish available quantities of oil, but the whole amount already obtained from the district is perhaps not less than 300,000 or 400,000 gallons. Owing to the difficulties of communication and of procuring casks sufficient for the oil, these wells have not yet been wrought in a continuous manner. Large quantities of oil are, however, taken out at intervals of some days, and it is probable that, if continuously worked, the supply would be still greater. Here, as in Pennsylvania, considerable variations are found in the quality of the oil. That from the wells on Black Creek is more liquid and less dense than the oil from Kelly's wells on Bear Creek, and it is said that wells recently sunk to a considerable depth in the rock have yielded an oil still thinner, lighter coloured, and less dense, which is prized as being more profitable for refining. The present wholesale price of the crude oil from Kelly's wells, delivered at the Wyoming station on the Grand Trunk Railway, is about thirteen cents a gallon. The oil obtained by Mr. Williams is refined in Hamilton, while that from the northern part of the township has hitherto been sent to Boston, though refining works are now being erected at the wells. The process of refining consists in rectifying by repeated distillations, by which the oil is separated into a heavier part employed for lubricating machinery, and a lighter oil, which, after being purified and deodorised by a peculiar treatment with sulphuric acid, is fit for burning in lamps.

These wells occur along the line of a low, broad anticlinal axis, which runs nearly east and west through the Western Peninsula of Canada, and brings to the surface in Enniskillen the shales and limestones of the Hamilton group, which are there covered with a few feet of clay. The oil doubtless rises from the Corniferous limestone, which, as we have seen, contains petroleum. This being lighter than the water which permeates at the same time the porous strata, rises to the higher portion of the formation, which is the crest of the anticlinal axis, where the petroleum of a considerable area accumulates, and slowly finds its way to the surface through vertical fissures in the overlying Hamilton shales, giving rise to the oil springs of the region. The oil is met with at various depths. In some cases an abundant supply is obtained at forty feet, while near by it is only met with at three or four times that depth, and sometimes only in small quantities. Everything points to the existence of separate fissures communicating with a deep-seated source. At Kelly's wells, however, it would appear that a reservoir has been formed much nearer the surface, where in a bed of gravel and boulders, underlying the superficial clays, the oil rising from the rocks beneath has accumulated. The inflammable gas which issues from the wells is not necessarily connected with the petroleum, inasmuch as it is an almost constant product of the decomposition of organic matters, and is copiously evolved from rocks which are destitute of bitumen. It is similar to the gas of marshes and to the fire-damp of coal mines. A curious circumstance is, however, noticed by Mr. Robb; the gas which accumulates in the oil pits becomes charged with vapours which produces upon the workmen a sort of intoxication like nitrous oxide. This is not surprising when we remember that volatile hydrocarbons, like amylene, closely related to the hydrocarbons of petroleum, produce similar effects when their vapour is respired.

The oil wells of the United States are for the most part sunk in the sandstones which form the summit of the Devonian series; but the oils of Western Virginia and Southern Ohio rise through the coal measures which overlie the Devonian strata, while the wells of Enniskillen are situated much lower, and are sunk in the Hamilton shales, which immediately overlie the Corniferous or Devonian limestone. It is not impossible that in Ohio some of the higher strata, such as the sandstone, were originally impregnated with bitumen, but in Canada, from the absence of this substance diffused through the shales in question, we are foreed to assign it to a lower horizon, which is doubtless that of the bituminous Devonian limestone. This view I have for some time maintained in opposition to those who conceive the bitumen to be derived from the black pyroschists; (see my lecture before the Board of Arts, reported in the *Montreal Gazette* of March 1, where I asserted that the source of the petroleum was to be sought in the bituminous Devonian and Silurian limestones); besides the Corniferous limestone (Devonian), we have shown that both the Niagara and the Trenton (of Upper and Lower Silurian age) contain petroleum. The question of the extent of the supply of petroleum is not easily answered; the oil now being wrought is the accumulated drainings of ages, concentrated along certain lines of elevation, and the experience of other regions has shown that these sources are sooner or later exhausted; but though the springs of Agrigentum, like those of Derbyshire, have nearly ceased to flow, those of Burmah and Persia still furnish, as they have for ages past, immense quantities of oil, nothing but experience can tell us the richness of the subterranean reservoirs. It is not probable that the Devonian limestone is equally rich in petroleum throughout its whole distribution, but the exposures of it in the west are too few to enable us as yet to say in what portions the petroleum predominates; as, however, this rock underlies more than one half of the Western Peninsula, we may look for petroleum springs much further east than Enniskillen. A well yielding considerable quantities of petroleum is said to occur in the township of Dereham, about a quarter of a mile southwest of Tilsonburg, and we may reasonably expect to find others along the line of the anticlinal, or of the folds which are subordinate to it.

It is now many years since Sir William Logan described the occurrence of petroleum springs in Gaspé, and collected specimens of the oil, which are preserved in the Geological Museum. One of these, near Gaspé Bay, is described as occurring on the south side of the St. John's River, about a mile and a-half above Douglas Town, where it may be collected by digging pits in the mud on the beach. Another locality is about 200 yards

up a small fork of the Silver Brook, which falls into the south-west arm six or seven miles above Gaspé Basin. The oil collects in pools along the stream, and may be gathered in considerable quantities. The cavities in a greenstone dyke on Gaspé Bay were also found to be filled with petroleum, and the odour of it from the rock was perceived at a considerable distance. The dyke, which marks a fold in the stratification, runs in the direction of the petroleum springs, and the evidences of the distribution of petroleum are thus, as Sir William Logan has remarked, visible along a line of twenty miles (Report for 1844, p. 41). Attention has recently been drawn to these indications, and a company formed with a view of exploring this region for petroleum. Here, as well as in Western Canada and the United States, the connection is evident between the springs and undulations of the strata which favour the accumulation of the petroleum.

(To be continued.)

On a Regenerative Gas Furnace, as applied to Glass-houses, Puddling, Heating, &c., by Mr. C. William Siemens, *of London.**

The arrangement of furnaces about to be described is applicable with the greatest advantage in cases where great heat has to be maintained: as in melting and refining glass, steel, and metallic ores, in puddling and welding iron, and in heating gas and zinc retorts, &c. The fuel employed, which may be of very inferior description, is separately converted into a crude gas, which in being conducted to the furnace has its naturally low heating power greatly increased by being heated to nearly the high temperature of the furnace itself, ranging to above 3000° F.; undergoing at the same time certain chemical changes, whereby the heat developed in its subsequent combustion is increased. The heating effect produced is still further augmented by the air necessary for combustion being also heated separately to the same high degree of temperature, before mixing with the heated gas in the combustion chamber or furnace; and the latter is thus filled with a pure and gentle flame of equal intensity throughout the whole chamber. The heat imparted to the gas and air before mixing is obtained from the products of combustion, which after leaving the furnace are reduced to a temperature frequently not exceeding 250° F. on reaching the chimney, whereby great economy in fuel is produced, with other advantages.

The transfer of heat from the products of combustion to the air and gas entering the furnace is effected by means of regenerators, the principle of which has been recognised to some extent since the early part of the present century, but has not hitherto been carried out in any useful application in the arts, unless the respirator invented by Dr. Jeffreys be so considered. The discovery of this principle is ascribed to the Rev. Mr. Stirling, of Dundee, who, in conjunction with his brother, James Stirling, attempted as early as the year 1817 to apply it to the construction of a hot-air engine. Their engine did not, however, succeed, nor did Captain Ericsson's later attempts in the same direction lead to more satisfactory results. The economical principle of the regenerator having attracted the writer's attention in 1846, he constructed in the following year an engine in which superheated steam was used in conjunction with the regenerator. Many practical difficulties, however, prevented a realisation of the success which theory and experiments appeared to promise; but it is gratifying to find that one principle then adopted—that of superheating the steam—has since received the sanction of an extended application.

The employment of regenerators for getting up a high degree of heat in furnaces was suggested in 1857 by the writer's brother, Mr. Frederick Siemens, and has since been worked out by them conjointly through the several stages of progressive improvement. The results obtained by the earlier applications of the principle were communicated by the writer in a paper read at a former meeting of this Institution (see *Proceedings Inst. M.E.*, 1857, page 103); and two or three of the furnaces then described, employed for heating bars of steel, remain still in operation. In attempting, however, to apply the principle to puddling and other larger furnaces, serious practical difficulties arose, which for a considerable time frustrated all efforts: until, by adopting the plan of volatilising the solid fuel in the first instance, and employing it entirely in a gaseous form for heating purposes, practical results were at length attained surpassing even the sanguine expectations previously formed.

In the early form of the regenerative heating furnace, which has been in continuous work during the last three years for heating bars of steel at Messrs. Marriott and Atkinson's Steel Works, Sheffield, and also at the Broughton Copper Works, Manchester, there is a single fire-place containing a ridge of fuel fed from the top; and two heating chambers, in which the bars of metal to be heated are laid, with a regenerator at the end of each chamber, by which the waste heat passing off from the furnace is intercepted on its way to the chimney, and transferred to the air entering the furnace. Each regenerator is composed of a mass of open fire-bricks, exposing a large surface for the absorption of heat, through which the products of combustion are made to pass from the furnace, and are thus gradually deprived of nearly all their heat previous to escaping into the chimney: the end of the regenerator nearest the furnace becomes gradually heated to nearly the temperature of the furnace itself, while the other end next the chimney remains comparatively cool. The direction of the draught being now reversed by means of a valve, the air entering the furnace is made to pass through the heated regenerator in the contrary direction, encountering first the cooler portions of the brickwork, and acquiring successive additions of heat in passing through the regenerator, until it issues into the first chamber of the furnace at a very high temperature, and traversing the ridge of fuel produces a flame which fills the second heating chamber, whence the products of combustion, passing through the second cold regenerator, deposit their heat successively in the inverse manner, reaching the chimney comparatively cool. By thus alternating the current through the two regenerators, a high degree of temperature is maintained constantly in the furnace. This arrangement of furnace is evidently applicable only in exceptional cases where two chambers are to be heated alternately, nor does it admit of being carried out upon a large scale.

In heating a single chamber the expedient was resorted to of providing two fire-places to be traversed in succession by the heated air, with the heated chamber placed between, as in the furnace shown in the drawings accompanying the previous paper (*Proceedings Inst. M.E.* 1857, plate 118). Here the difficulty arose that the air, the oxygen of which was already combined with carbon (forming carbonic acid) in traversing the first fire-place, took up a second equivalent of carbon

* Read before the Birmingham Institution of Mechanical Engineers.

(forming carbonic oxide) in traversing the second, so that the fuel of the second fire was consumed to no purpose. In order to diminish this loss, and also avoid impairing the draught by a double resistance, the ridges of fuel were discontinued, and the coal was fed into the furnace from the sides, resting on a solid hearth, to be there volatilised by the heated air passing over it. By frequently stirring the first fire its combustion was favoured until the current was reversed, when it was left undisturbed until the next change, and so on alternately. It was found very difficult, however, to maintain an active and uniform combustion, and to burn the purely carbonaceous substance that was left in the fire-place after the gaseous portion of the fuel had been volatilised; and it had frequently to be raked out in order to make room for fresh gaseous fuel. This circumstance led to the first step towards the employment of fuel in the form of gas, by providing a small grate below the heap of fuel, through which a gentle current of air was allowed to enter, forming carbonic oxide, which afterwards further combined with oxygen on meeting with the hot current of air entering the furnace from the regenerator. The two fire-places of alternating activity were, however, attended with considerable practical inconvenience: the furnace-men, in particular, disliked the idea of attending two fire-places instead of one, and being little interested in the saving of fuel, took no pains to work the furnace in a satisfactory manner.

It therefore became necessary to devise a plan of heating a single chamber continuously by one fire-place, in combination with the alternate reversal of currents through the regenerators, but without reversing the direction of the flame. This was accomplished by means of double reversing valves, and was practically carried out in a puddling furnace that worked for a considerable length of time at the ironworks of Messrs. R. and W. Johnson, near Manchester. The two regenerators were placed longitudinally side by side, with a flue between, underneath the puddling chamber, and the fire-place was put at one end of the puddling chamber, as in an ordinary puddling furnace, and fed with fuel from above. The heated air from the first regenerator was brought up at the back of the fire-place, and meeting there with the fuel produced the required flame in the puddling chamber; whence the products of combustion passed down at the end of the chamber, and were carried back along the flue below to the hot end of the second regenerator, through which they made their way to the chimney. For reversing the currents through the regenerators two valves were needed, connected by a lever, one at the hot end of the regenerators near the fire, and the other at the cool end next the chimney; whereby the heated air was made to enter the fire-place by the same passage as previously, and the direction of the flame through the puddling chamber was not changed. By this arrangement the regenerative furnace was assimilated as nearly as could be to an ordinary puddling furnace in form and mode of working. The few furnaces constructed in this manner produced a great heat with little more than one-half the consumption of fuel of ordinary furnaces in doing the same amount of work. A considerable saving of iron was also effected in puddling, owing to the absence of strong cutting draughts, a mild draught being found sufficient to produce the necessary heat. There still remained drawbacks, however, which prevented an extensive application of this form of furnace: the fire required frequent attention, and it was difficult to maintain a uniform volume of flame in the furnace; the reversing valve at the hot end of the regenerators was moreover liable to get out of order, and the furnace was costly in construction.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On the Detection of Adulterations in Essential Oils, by Dr. Bolley.

Amongst the foreign substances employed to adulterate essential oils we may mention, as the most frequent, alcohol, fatty oils, and resinous matter; but volatile oils of a lower price are also frequently employed, as, for instance, oil of turpentine, rosemary, &c.

I. Alcohol when mixed in considerable proportion with essences is easy to detect. It is only necessary to shake up the suspected substance with water in a graduated tube and then let it remain quiet for some time. The true volume of the oil will be shown by the removal of the alcohol, whilst the bulk of the water is increased.

M. Borsarelli proposes to pour the suspected oil into a graduated glass tube, and then to introduce gradually small pieces of perfectly dry chloride of calcium. The tube is then to be closed, placed in a water bath for four or five minutes, shaking it several times. The chloride of calcium dissolves in the alcohol, and thereby diminishes the layer of oil. If the alcohol is only present in small quantity, the chloride merely becomes moist and pasty; if none is present, the salt remains dry and unchanged.

M. Bernouilli, instead of chloride of calcium, proposes acetate of potash, which, employed in the same way, dissolves in the alcohol, but undergoes no change in pure essential oils.

The presence of alcohol in essential oils may also be recognised by shaking them with olive oil, which dissolves them readily, leaving the alcohol floating on the surface.

II. The presence of alcoholic soap is easily recognised by the froth which forms on shaking the oil. If an acid is added to it a fatty matter is precipitated, generally in the solid state, and the liquid on which the oil floats contains, in addition to the acid which has been added, the alkali removed from the soap.

III. The fatty oils render essential oils rather thick, and facilitate the formation of air bubbles on the surface. A pure essential oil mixed with eight times its weight of alcohol, sp. gr. 0·823, dissolves entirely, whilst the fat oil remains intact, and separates, provided it be not castor oil, which is soluble in alcohol.

A fatty oil mixed with a volatile oil gives when heated a very definite stain on white paper, which is permanent.

IV. An admixture of resin also communicates a stain to paper; but this stain is readily removed by alcohol, which does not affect the mark formed by a fatty oil.

V. Those adulterations which consist in mixing essential oils with other essences of a less price, are often very difficult to detect. Lately, two reactions have been discovered which admit of the division of the volatile oils into two great groups.

It is known that some contain no oxygen, but the greater number do contain that element; to determine to which of these groups a given oil belongs, Mr. Hope recommends the following plan to be adopted:—Precipitate a salt of copper with nitro-prusside of sodium, collect the precipitate on a filter, wash and dry it at 100° C. The precipitate is then used in very small proportion (a fragment, about the size of a pin's head),

which is mixed in a glass tube with a few drops of the oil to be tested, boil for a few minutes, and then allow it to stand. If the essential oil contains no oxygen, as, for instance, oil of turpentine, a green or greenish-blue precipitate will be observed, whilst the supernatant oil is colourless or slightly yellow. With oils which do contain oxygen, and which have not been mixed with other oils free from this element, the nitro-prusside of copper becomes black, grey, or brown; whilst the supernatant oil assumes a darker shade than in the first instance, becoming of a brownish-yellow or green colour.

The essential oils of orange, citron, juniper, and of savin, behave like oil of turpentine.

The essential oils of cumin, fennel, lavender, peppermint, balm, marjoram, sage, absinthe, cajeput, sassafras, and rue, contain oxygen.

VI. Oil of neroli is often mixed with an essence of a less price extracted from the calices and buds of orange-flowers. This fraud is recognised by placing in the oil a piece of sugar, which is afterwards dissolved in water, to which the oil communicates a bitterness if it has been mixed.

VII. The presence of oil of turpentine in petroleum is recognised by grinding a few drops of the suspected mixture with a little water and iodide of potassium. The aqueous solutions presently become yellow, and frequently orange, if the petroleum contains oil of turpentine; whilst this effect is not produced if the petroleum is pure. This test is sufficient to recognise an addition of $\frac{1}{10}$th of oil of turpentine.

VIII. Essential oil of bitter almonds is frequently mixed in commerce with nitro-benzol or essence of mirbane. To detect this adulteration, Mr. Maisch recommends that recourse be had to the reaction which an alcoholic solution of potash exerts upon nitro-benzol. Thus, whilst pure oil of bitter almonds changes, under the action of the alcoholic solution of potash, into benzoic acid, which unites with the alkali, nitro-benzol submitted to the same influence changes into a deep brown resin, which is insoluble in alcohol and ether, but which solidifies into yellow crystals, to which M. Zinin has given the name of azoxibenzol.

To perform this experiment, dissolve about 1 gramme of the suspected oil in 8 grammes of alcohol, add 1 gramme of hydrate of potash, and heat the mixture until two-thirds of the alcohol has evaporated. Then put the vessel on one side. If the oil of bitter almonds were pure the liquid will only be of a light brown colour, capable of mixing with water, and free from all crystalline deposit. If, on the contrary, it contained nitro-benzol, a quantity of brown resin will be seen, hard and crystalline, and floating in the lighter coloured alkaline liquid, and being greater or less in quantity according to the proportion of nitro-benzol.—*Journal de Pharmacie et de Chimie.*

PHYSICAL SCIENCE.

On the Utilisation of the Power involved in the Rise and Fall of the Tides.

The tendency of modern scientific discovery has been to show that all the various forms of force with which we are acquainted are mutually convertible into one another. Thus, of the six forces known to us in connection with the universe—gravitation, motion, light, heat, electricity, and chemical affinity—it is well known that any one of the five latter is capable, by appropriate means, of generating the other four, the force of gravitation being capable, through the medium of motion, of giving rise to the other five forces, whilst it cannot itself be generated. Gravitation may therefore be assumed to be the elemental force, since it is the only one of the six which will generate all the others. So accurately have these correlations been studied, that the quantitative value of gravitation has even been ascertained, it having been found that the mechanical force required to lift 772 pounds to the height of one foot is capable, when converted into the force of heat, of raising the temperature of one pound of water 1° F. In other words, this amount of heat may be generated by an appropriate utilisation of the gravitating pull, exerted by a weight of 772 pounds during its downward movement through the space of one foot. Supposing, therefore, we were in possession of an unlimited number of 772-pound weights, and were to employ in the most judicious manner the force thus evolved in their downward progress, we should have an unlimited reservoir of power which could be converted at will into light, heat, electricity, or chemical affiinty, and could be made to toil for human benefit without any corresponding expenditure of human labour so long as the weights continued their downward progress unarrested. If, however, any good were to be gained by such a machine, it must be managed so that the motive force—gravitation—should always remain on the pull, and this is, and always will be, the obstacle to the attainment of perpetual motion; the act of overcoming the force of gravity to re-raise the weights requiring the expenditure of exactly the same amount of power as has been generated during their downward fall; and so, before we can seriously discuss the feasibility of such a machine, we must find a perpetual flow of gravitating force always at hand, craving to be satisfied, and yet inexhaustible. In other words, we must construct a clock which will wind itself up when the weight has run down without any expenditure of human power.

Sitting by the sea-shore a few days since, we could not help noticing the vast reservoir of mechanical power existing in the ocean. We do not refer to the noisy dash of the waves as they break upon the beach, but to the infinitely mightier, although silent and progressive, energy exerted in the gradual rise and fall of the tides. Compared with the stupendous power capable of being utilised for man's benefit, and present in the rise or fall of millions upon millions of tons of water through a space of ten or twenty feet four times a-day, all the steam, water, or wind power in the world, together with the united muscular force of every living being, human and animal, sink into utter insignificance. We will try to form some idea of this power. Let us suppose that by the action of the tides the difference of level of the surface of the ocean at a certain spot is 21 feet between high and low water; omitting for the present all consideration of the power of the subjacent liquid, what is the mechanical value of a space of 100 yards square of this water? 100 yards square by 21 feet deep equals 70,000 cubic yards of water, which is lifted to a height of 21 feet, or to 1,470,000 cubic yards lifted to a height of 1 foot. Now, since one cubic yard of water weighs about 1683 pounds, 1,470,000 cubic yards weigh 2,474,010,000 pounds, which is lifted in six hours. This is equivalent to lifting a weight of 412,335,000 foot pounds in one hour; and since one horse-power is considered equivalent to raising 1,800,000 foot pounds per hour, we have locked up in every 100 yards square of

sea surface, a power equal to a 230 horse-power steam-engine, acting, be it remembered, day and night to the end of time, requiring no supervision, and costing nothing after the first outlay but the wear and tear of machinery.

By means of appropriate machinery connected with this tidal movement, any kind of work could be readily performed. Water could be hoisted or air compressed to any desired extent, so as to accumulate power for future use, or for transport to distant stations. Light of surpassing splendour could be generated by means of magneto-electric machines; and with a very little exercise of ingenuity, every lighthouse on the coast could be illuminated with sun-like brilliancy, and with absolutely no expenditure of fuel; the very same mechanical power of the ocean, which in its brute force would dash the helpless vessel to pieces against the rocks, being bound and coerced like the genii in Eastern tales, and transformed by man's intellect into a luminous beacon to warn the mariner against the approach of danger.

INTERNATIONAL EXHBIITION.

Class II.

Chemical Substances and Products, and Pharmaceutical Products.

(*Continued from page* 8.)

We return to Class II., which we quitted for a time merely for the sake of variety, and by no means because everything worthy of remark in the department had been noticed. One of our most important chemical productions, perhaps the most important, is that of soda. For the manufacture of this article we have peculiar facilities; and for its consumption a large home demand, as well as a large export trade. It was to be expected, therefore, that our countrymen would excel in this article, and the expectation is quite fulfilled. Cases 461, 520, 537, and 571 attest the truth of our remarks. In the last-numbered case the Messrs. Muspratt exhibit soda-ash of various per-centages, and not refined, the appearance of which is highly creditable to them. Caustic soda is comparatively a new production, but is already an article in great requisition. If we remember rightly, there was no specimen of it in the Exhibition of 1851, but to what perfection it has already been brought will be seen in Case 520, in which Messrs. Gaskell, Deacon, and Co. exhibit a mass of crystals of the compound NaO_3HO. This is, of course, a *fancy* specimen, but the commercial samples of the caustic soda in the same case are remarkably clean, and fitted for the manufacture of the finest soaps. The visitor will also remark a fine mass of borax in this case. No 537 also contains clean caustic soda, and some crystals of the bicarbonate, which will be sure to attract the visitor's notice: the latter are, perhaps, the finest specimens of the article in the Exhibition. There are other chemicals equally well represented: acetate of lead, for example, in Cases 566 and 626; nitrate of potash, in 587; the yellow and red prussiates of potash, in 535; and chlorate of potash, 460. All these are beautiful, and show, at all events, what their manufacturers could produce if the production of such articles would pay.

The display of alums by various Companies and firms calls for no remark from us: they speak for themselves.

There are some cases in this class illustrating processes which deserve to be noticed. The first is Mr. Stanford's (607). We have so recently (page 167 of our last volume) given a detailed account of Mr. Stanford's ingenious method of extracting all the valuable constituents of seaweeds, that we need not repeat it here. Our readers will find in this case samples illustrating the process, or rather processes in all their stages, from the pressed weeds to the various refined products, which last do Mr. Stanford the greatest credit. We may again express a hope that Mr. Stanford will soon have the opportunity of working his process on a grand scale. Case 617 contains a series illustrating a "new process for extracting alkali from natural alkaliferous silicates." When our organic sources of alkali fail, and the forests of Russia and America have all been consumed to supply us with potashes, it is comfortable to reflect that there is a large field for chemical enterprise in our primitive rocks. Mr. Ward's process is that familiarised to our readers in the papers of Mr. Field (Chemical News, vol. i. p. 217), and consists in heating the alkaliferous silicate with fluor spar, and carbonate of lime. The alkali is then dissolved out by water, and refined for commerce. Next to this is a series, by the same exhibitor, illustrating a new process for separating the animal and vegetable ingredients of mixed rags. Rags of mixed fabrics,—alpacas, for example,—are exposed for some time to super-heated steam, by which the wool is converted into a sort of humus, and can be rubbed out, while the cotton remains unacted on. The humus is then available for manure, and the cotton for paper-making. In 471, Messrs. Bartlett and Co. exhibit soluble silicates, artificial stones, and preparations illustrating their stone preserving process. The last is sufficiently interesting and novel to demand particular notice. All our readers know that, under ordinary circumstances, a solution of alumina and potash and a solution of silicate of potash when mixed together would give an immediate precipitate. Mr. Barth, however, has made the curious discovery that there are degrees in strength and of alkalinity at which the mixed solutions give no immediate precipitate, but in time dry up to a solid, opaque, glassy mass, which is capable of resisting the action of hot and cold water, and also of hydrochloric and sulphuric acids. There seems to be formed, in fact, a sort of artificial felspar, in which all the solid ingredients of the solutions unite. The method of applying such a solution to a building is simple enough; it has only to be paid on like paint or an ordinary wash, and, heavy rain not interfering, it soon dries up and coats the building with a solid, glassy covering, capable, no doubt, of resisting atmospheric influences for any number of years.

Among the cases exhibited by firms producing pharmaceutical chemicals, one of the first places belongs to that of Messrs. Huskisson and Sons. There are preparations here of great beauty and excellence, and commercial samples of many articles which are not surpassed in the Exhibition. M'Farlane and Co., of Edinburgh, well known as one of our largest manufacturers of opium alkaloids, make a fine display of these articles in Case 660, and also a series illustrating the manufacture of morphia. A very fine specimen of crystallised codein will be sure to attract the visitor's notice. Another Edinburgh firm, the Messrs. Smith, also exhibit (604) morphia salts, and the narceine produced from 1000*l.* worth of opium. There is also some crystallised papaverine, and a novelty in the shape of thebo-lactic acid, an acid discovered by Mr. Smith himself. Some other articles, aloïne, caffeine, &c., make up, with those

before mentioned, a display highly creditable to the Messrs. Smith.

Some other chemical and pharmaceutical contributors deserve a passing notice. The cases of Messrs. May and Baker (565), Johnson and Sons (541), Davy Mackmurdo and Co. (505), Cox and Gould (502), Baily and Son (464), Hirst, Brooke and Tomlinson (528), and Dunn, Heathfield and Co., are all worthy the attention of the visitor.

Mr. Barnes has a case (469) containing interesting articles in the shape of various organic acids and their ethers; and there are some remarkable preparations by Mr. Eschwege (513), which deserve a most particular notice. This gentleman has produced "potable wood naphtha," all we can say about which at present is, that, whatever it may be, it is sweet and potable, and unlike any other wood-spirit we ever saw.

Professor Brodie's chemically disintegrated and purified graphite (486) will be looked at with wonder by all who remember how intractable a substance graphite was considered little more than a year ago. The purified graphite here exhibited is a beautiful article, superior, no doubt, for all artistic purposes to the finest Cumberland lead ever seen.

Coal distillation products are, of course, numerous, and include contributions from Mr. Young (632),—the first who made these products commercial articles,—and Messrs. Miller and Co., of Glasgow (568), who have indirectly contributed so much to our scientific knowledge of their constituents. Other specimens, of an ordinary character, will be seen at 597, contributed by Mr. Shand.

Aniline, and aniline-dyes, in addition to those we mentioned before, are exhibited by Messrs. Wilson and Fletcher (625), Roberts, Dale and Co. (588), and others.

Products of the dry distillation of wood are shown by the Melinerythan Chemical Company (566).

Manures, dyes, and dye-stuffs we are compelled to pass over.

It would be wrong, however, to omit to mention without the highest commendation the magnificent case of artist's colours (627) contributed by Messrs. Winsor and Newton. It is decidedly the most attractive-looking case in the Class, and contains besides some new colours which deserve the attention of the chemist. The display of Messrs. Rowney and Co. (591) must also be commended for the taste as well as the colours exhibited.

Rougher colours and paints of all kinds are numerous, but hardly deserve particular notice, except the antimonial pigments of Messrs. Hallett and Co. (525), which are novelties likely to prove of value.

There are yet a few cases which we very reluctantly pass for the present, but it would be impossible to do them adequate justice in a series of short notices, as these must necessarily be. Such, for example, are the cases of Dr. Stenhouse (608), with its rare and valuable contents, and of Mr. Church (497). These deserve separate and special notices, which we hope shortly to devote to them. And how could justice be done in a volume to Dr. Crisp for his collection of colours from the biles of 500 animals (503)! which we therefore leave without further notice.

Before these lines are read the prizes will have been distributed, and no doubt with discrimination; but the sensation with which we leave the department is one of devout thankfulness that, where there is so much of first-class excellence, we are relieved from the responsibility of deciding who shall receive medals.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, June 6, 1862.

The Duke of Northumberland, *K.G., F.R.S., President, in the Chair.*

A Lecture, by John Tyndall, *Esq., F.R.S., Professor of Natural Philosophy, Royal Institution, "On Force."*

The existence of the International Exhibition suggested to our Honorary Secretary the idea of devoting the Friday evenings after Easter of the present year to discourses on the various agencies on which the material strength of England is based. He wished to make iron, coal, cotton, and kindred matters, the subjects of these discourses; opening the series by a discourse on the Great Exhibition itself; and he wished me to finish the series by a discourse on "Force" in general. For some months I thought over the subject at intervals, and had devised a plan of dealing with it; but three weeks ago I was induced to swerve from this plan, for reasons which shall be made known towards the conclusion of the discourse.

We all have ideas more or less distinct regarding force; we know in a general way what muscular force means, and each of us would less willingly accept a blow from a pugilist than have his ears boxed by a lady. But these general ideas are not now sufficient for us; we must learn how to express numerically the exact mechanical value of the two blows; this is the first point to be cleared up.

A sphere of lead weighing 1 lb. was suspended at a height of 16 feet above the theatre floor. It was liberated, and fell by gravity. That weight required exactly a second to fall to the earth from that elevation; and the instant before it touched the earth, it had a velocity of 32 feet a second. That is to say, if at that instant the earth were annihilated, and its attraction annulled, the weight would proceed through space at the uniform velocity of 32 feet a second.

Suppose that instead of being pulled downward by gravity, the weight is cast upward in opposition to the force of gravity, with what velocity must it start from the earth's surface in order to reach a height of 16 feet? With a velocity of 32 feet a second. This velocity imparted to the weight by the human arm, or by any other mechanical means, would carry the weight up to the precise height from which it has fallen.

Now, the lifting of the weight may be regarded as so much mechanical work. I might place a ladder against the wall, and carry the weight up a height of 16 feet; or I might draw it up to this height by means of a string and pulley, or I might suddenly jerk it up to a height of 16 feet. The amount of work done in all these cases, as far as the raising of the weight is concerned, would be absolutely the same. The absolute amount of work done depends solely upon two things: first of all, on the quantity of matter that is lifted; and secondly, on the height to which it is lifted. If you call the quantity or mass of matter m, and the height through which it is lifted h, then the product of m into h, or mh, expresses the amount of work done.

Supposing, now, that instead of imparting a velocity of 32 feet a second to the weight we impart twice this speed, or 64 feet a second. To what height will the weight rise? You might be disposed to answer, "To twice the height;" but this would be quite incorrect. Both theory and experiment inform us that the weight would rise to four times the height; instead of twice 16, or 32 feet, it would reach four times 16, or 64 feet. So also, if we treble the starting velocity, the weight would reach nine times the height; if we quadruple the speed at starting, we attain sixteen times the height. Thus, with a velocity of 128

feet a second at starting, the weight would attain an elevation of 256 feet. Supposing we augment the velocity of starting seven times, we should raise the weight to 49 times the height, or to an elevation of 784 feet.

Now the work done—or, as it is sometimes called, the *mechanical effect*—as before explained, is proportional to the height, and as a double velocity gives four times the height, a treble velocity nine times the height, and so on, it is perfectly plain that the mechanical effect increases as the square of the velocity. If the mass of the body be represented by the letter m, and its velocity by v, then the mechanical effect would be represented by $m\,v^2$. In the case considered, I have supposed the weight to be cast upward, being opposed in its upward flight by the resistance of gravity; but the same holds true if I send the projectile into water, mud, earth, timber, or other resisting material. If, for example, you double the velocity of a cannon-ball, you quadruple its mechanical effect. Hence the importance of augmenting the velocity of a projectile, and hence the philosophy of Sir William Armstrong in using a 50 lb. charge of powder in his recent striking experiments.

The measure then of mechanical effect is the mass of the body multiplied by the square of its velocity.

Now, in firing a ball against a target, the projectile, after collision, is often found hissing hot. Mr. Fairbairn informs me that in the experiments at Shoeburyness it is a common thing to see a flash of light, even in broad day, when the ball strikes the target. And if I examine my lead weight after it has fallen from a height I also find it heated. Now, here experiment and reasoning lead us to the remarkable law that the amount of heat generated, like the mechanical effect, is proportional to the product of the mass into the square of the velocity. Double your mass, other things being equal, and you double your amount of heat; double your velocity, other things remaining equal, and you quadruple your amount of heat. Here then we have common mechanical motion destroyed and heat produced. I take this violin bow and draw it across this string. You hear the sound. That sound is due to motion imparted to the air, and to produce that motion a certain portion of the muscular force of my arm must be expended. We may here correctly say, that the mechanical force of my arm is converted into music. And in a similar way we say that the impeded motion of our descending weight, or of the arrested cannon-ball, is converted into heat. The mode of motion changes, but it still continues motion; the motion of the mass is converted into a motion of the atoms of the mass; and these small motions communicated to the nerves, produce the sensation which we call heat. We, moreover, know the amount of heat which a given amount of mechanical force can develope. Our lead ball, for example, in falling to the earth generated a quantity of heat sufficient to raise the temperature of its own mass three-fifths of a Fahrenheit degree. It reached the earth with a velocity of 32 feet a second, and forty times this velocity would be a small one for a rifle bullet; multiplying three-fifths by the square of 40 we find that the amount of heat developed by collision with the target would, if wholly concentrated in the lead, raise its temperature 960 degrees. This would be more than sufficient to fuse the lead. In reality, however, the heat developed is divided between the lead and the body against which it strikes; nevertheless, it would be worth while to pay attention to this point and to ascertain whether rifle-bullets do not, under some circumstances, show signs of fusion.

From the motion of sensible masses, by gravity and other means, the speaker passed to the motion of atoms towards each other by chemical affinity. A collodion balloon filled with a mixture of chlorine and hydrogen was hung in the focus of a parabolic mirror, and in the focus of a second mirror 20 ft. distant a strong electric light was suddenly generated; the instant the light fell upon the balloon the atoms within it fell together with explosion, and hydrochloric acid was the result. The burning of charcoal in oxygen was an old experiment, but it had now a significance beyond what it used to have; we now regard the act of combination on the part of the atoms of oxygen and coal exactly as we regard the clashing of a falling weight against the earth. And the heat produced in both cases is referable to a common cause. This glowing diamond, which burns in oxygen as a star of white light, glows and burns in consequence of the falling of the atoms of oxygen against it. And could we measure the velocity of the atoms when they clash, and could we find their number and weight, multiplying the mass of each atom by the square of its velocity, and adding all together, we should get a number representing the exact amount of heat developed by the union of the oxygen and carbon.

Thus far we have regarded the heat developed by the clashing of sensible masses and of atoms. Work is expended in giving motion to these atoms or masses, and heat is developed. But we reverse this process daily, and by the expenditure of heat execute work. We can raise a weight by heat; and in this agent we possess an enormous store of mechanical power. This pound of coal, which I hold in my hand, produces by its combination with oxygen an amount of heat which, if mechanically applied, would suffice to raise a weight of 100 lbs. to a height of 20 miles above the earth's surface. Conversely, 100 lbs. falling from a height of 20 miles, and striking against the earth, would generate an amount of heat equal to that developed by the combustion of a pound of coal, Wherever work is done by heat, heat disappears. A gun which fires a ball is less heated than one which fires blank cartridge. The quantity of heat communicated to the boiler of a working steam-engine is greater than which could be obtained from the re-condensation of the steam after it had done its work; and the amount of work performed is the exact equivalent of the amount of heat lost. Mr. Smyth informed us in his interesting discourse, that we dig annually 84 millions of tons of coal from our pits. The amount of mechanical force represented by this quantity of coal seems perfectly fabulous. The combustion of a single pound of coal, supposing it to take place in a minute, would be equivalent to the work of 300 horses; and if we suppose 108 millions of horses working day and night, with unimpaired strength, for a year, their united energies would enable them to perform an amount of work just equivalent to that which the annual produce of our coal-fields would be able to accomplish.

Comparing the energy of the force with which oxygen and carbon unite together, with ordinary gravity the chemical affinity seems almost infinite. But let us give gravity fair play; let us permit it to act throughout its entire range. Place a body at such a distance from the earth that the attraction of the earth is barely sensible, and let it fall to the earth from this distance. It would reach the earth with a final velocity of 36,747 feet in a second; and on collision with the earth the body would generate about twice the amount of heat generated by the combustion of an equal weight of coal. We have stated that by falling through a space of 16 feet our lead bullet would be heated three-fifths of a degree; but a body falling from an infinite distance has already used up 1,299,999 parts out of 1,300,000 of the earth's pulling power, when it has arrived within 16 feet of the surface; on this space only $\frac{1}{1300000}$ths of the whole force is exerted.

Let us now turn our thoughts for a moment from the earth towards the sun. The researches of Sir John Herschel and M. Pouillet have informed us of the annual expenditure of the sun as regards heat; and by an easy calculation we ascertain the precise amount of the expenditure which falls to the share of our planet. Out of 2300 million parts of light and heat the earth receives one. The whole heat emitted by the sun in a minute would be competent to boil 12,000 millions of cubic miles of ice-

cold water. How is this enormous loss made good? Whence is the sun's heat derived, and by what means is it maintained? No combustion, no chemical affinity with which we are acquainted would be competent to produce the temperature of the sun's surface. Besides, were the sun a burning body merely, its light and heat would assuredly speedily come to an end. Supposing it to be a solid globe of coal, its combustion would only cover 4600 years of expenditure. In this short time it would burn itself out. What agency can then produce the temperature and maintain the outlay? We have already regarded the case of a body falling from a great distance towards the earth, and found that the heat generated by its collision would be twice that produced by the combustion of an equal weight of coal. How much greater must be the heat developed by a body falling towards the sun! The maximum velocity with which a body can strike the earth is about 7 miles in a second; the maximum velocity with which it can strike the sun is 390 miles in a second. And as the heat developed by the collision is proportional to the square of the velocity destroyed, an asteroid falling into the sun with the above velocity would generate about 10,000 times the quantity of heat generated by the combustion of an asteroid of coal of the same weight. Have we any reason to believe that such bodies exist in space, and that they may be raining down upon the sun? The meteorites flashing through the air are small planetary bodies, drawn by the earth's attraction, and entering our atmosphere with planetary velocity. By friction against the air they are raised to incandescence and caused to emit light and heat. At certain seasons of the year they shower down upon us in great numbers. In Boston 240,000 of them were observed in nine hours. There is no reason to suppose that the planetary system is limited to "vast masses of enormous weight;" there is every reason to believe that space is stocked with smaller masses, which obey the same laws as the large ones. That lenticular envelope which surrounds the sun, and which is known to astronomers as the Zodiacal light, is probably a cloud of meteors; and moving as they do in a resisting medium they must continually approach the sun. Falling into it, they would be competent to produce the heat observed, and this would constitute a source from which the annual loss of heat would be made good. The sun, according to this hypothesis, would be continually growing larger; but how much larger? Were our moon to fall into the sun it would develope an amount of heat sufficient to cover one or two years' loss; and were our earth to fall into the sun a century's loss would be made good. Still, our moon and our earth, if distributed over the surface of the sun, would utterly vanish from perception. Indeed, the quantity of matter competent to produce the necessary effect would, during the range of history, produce no appreciable augmentation in the sun's magnitude. The augmentation of the sun's attractive force would be more appreciable. However this hypothesis may fare as a representant of what is going on in nature, it certainly shows how a sun might be formed and maintained by the application of known thermo-dynamic principles.

Our earth moves in its orbit with a velocity of 68,040 miles an hour. Were this motion stopped, an amount of heat would be developed sufficient to raise the temperature of a globe of lead of the same size as the earth 384,000° of the centigrade thermometer. It has been prophesied that "the elements shall melt with fervent heat." The earth's own motion embraces the conditions of fulfilment; stop that motion, and the greater part, if not the whole of her mass, would be reduced to vapour. If the earth fell into the sun, the amount of heat developed by the shock would be equal to that developed by the combustion of 6435 earths of solid coal.

There is one other consideration connected with the permanence of our present terrestrial conditions, which is well worthy of our attention. Standing upon one of the London bridges, we observe the current of the Thames reversed, and the water poured upward twice a-day. The water thus moved rubs against the river's bed and sides, and heat is the consequence of this friction. The heat thus generated is in part radiated into space, and then lost, as far as the earth is concerned. What is it that supplies this incessant loss? The earth's rotation. Let us look a little more closely at the matter. Imagine the moon fixed, and the earth turning like a wheel from west to east in its diurnal rotation. Suppose a high mountain on the earth's surface; on approaching the moon's meridian, that mountain is, as it were, laid hold of by the moon, and forms a kind of handle by which the earth is pulled more quickly round. But when the meridian is passed the pull of the moon on the mountain would be in the opposite direction, it now tends to diminish the velocity of rotation as much as it previously augmented it; and thus the action of all fixed bodies on the earth's surface is neutralized. But suppose the mountain to lie always to the east of the moon's meridian, the pull then would be always exerted against the earth's rotation, the velocity of which would be diminished in a degree corresponding to the strength of the pull. The tidal wave occupies this position—it lies always to the east of the moon's meridian, and thus the waters of the ocean are in part dragged as a brake along the surface of the earth; and as a brake they must diminish the velocity of the earth's rotation. The diminution, though inevitable, is, however, too small to make itself felt within the period over which observations on the subject extend. Supposing, then, that we turn a mill by the action of the tide, and produce heat by the friction of the millstones; that heat has an origin totally different from the heat produced by another mill which is turned by a mountain stream. The former is produced at the expense of the earth's rotation; the latter at the expense of the sun's radiation.

The sun, by the act of vaporisation, lifts mechanically all the moisture of our air. It condenses and falls in the form of rain,—it freezes and falls as snow. In this solid form it is piled upon the Alpine heights, and furnishes materials for the glaciers of the Alps. But the sun again interposes, liberates the solidified liquid, and permits it to roll by gravity to the sea. The mechanical force of every river in the world, as it rolls towards the ocean, is drawn from the heat of the sun. No streamlet glides to a lower level without having been first lifted to the elevation from which it springs by the mighty power of the sun. The energy of winds is also due entirely to the sun; but there is still another work which he performs, and his connection with which is not so obvious. Trees and vegetables grow upon the earth, and when burned they give rise to heat, and hence to mechanical energy. Whence is this power derived? You see this oxide of iron, produced by the falling together of the atoms of iron and oxygen; here also is a transparent gas which you cannot now see—carbonic acid gas—which is formed by the falling together of carbon and oxygen. These atoms thus in close union resemble our lead weight while resting on the earth; but I can wind up the weight and prepare it for another fall, and so these atoms can be wound up, separated from each other, and thus enabled to repeat the process of combination. In the building of plants carbonic acid is the material from which the carbon of the plant is derived; and the solar beam is the agent which tears the atoms asunder, setting the oxygen free, and allowing the carbon to aggregate in woody fibre. Let the solar rays fall upon a surface of sand; the sand is heated, and finally radiates away as much heat as it receives; let the same beams fall upon a forest, the quantity of heat given back is less than the forest receives, for the energy of a portion of the sun-beams is invested in building up the trees in the manner indicated. Without the sun the reduction of the carbonic acid cannot be effected, and an amount of sunlight is consumed exactly equivalent to the molecular work

done. Thus trees are formed; thus the cotton on which Mr. Bazley discoursed last Friday is formed. I ignite this cotton, and it flames; the oxygen again unites with its beloved carbon; but an amount of heat equal to that which you see produced by its combustion was sacrificed by the sun to form that bit of cotton.

But we cannot stop at vegetable life, for this is the source, mediate or immediate, of all animal life. The sun severs the carbon from its oxygen; the animal consumes the vegetable thus formed, and in its arteries a reunion of the severed elements take place, and produce animal heat. Thus, strictly speaking, the process of building a vegetable is one of winding up; the process of building an animal is one of running down. The warmth of our bodies, and every mechanical energy which we exert, trace their lineage directly to the sun. The fight of a pair of pugilists, the motion of an army, or the lifting of his own body up mountain slopes by an Alpine climber, are all cases of mechanical energy drawn from the sun. Not, therefore, in a poetical, but in a purely mechanical sense, are we children of the sun. Without food we should soon oxidise our own bodies. A man weighing 150 lbs. has 64 lbs. of muscle; but these, when dried, reduce themselves to 15 lbs. During an ordinary day's work, for eighty days, this mass of muscle would be wholly oxidised. Special organs which do more work would be more quickly oxidised: the heart, for example, if entirely unsustained, would be oxidised in about a week. Take the amount of heat due to the direct oxidation of a given amount of food; a less amount of heat is developed by this food in the working animal frame, and the missing quantity is the exact equivalent of the mechanical work which the body accomplishes.

I might extend these considerations; the work, indeed, is done to my hand—but I am warned that I have kept you already too long. To whom, then, are we indebted for the striking generalisations of this evening's discourse? All that I have laid before you is the work of a man of whom you have scarcely ever heard. All that I have brought before you has been taken from the labours of a German physician, named Mayer. Without external stimulus, and pursuing his profession as town physician in Heilbronn, this man was the first to raise the conception of the interaction of natural forces to clearness in his own mind. And yet he is scarcely ever heard of in scientific lectures, and even to scientific men his merits are but partially known. Led by his own beautiful researches, and quite independent of Mayer, Mr. Joule published his first paper on the "Mechanical Value of Heat," in 1843; but in 1842 Mayer had actually calculated the mechanical equivalent of heat from data which a man of rare originality alone could turn to account. From the velocity of sound in air Mayer determined the mechanical equivalent of heat. In 1845 he published his Memoir on "Organic Motion," and applied the mechanical theory of heat in the most fearless and precise manner to vital processes. He also embraced the other natural agents in his chain of conservation. In 1853 Mr. Waterston proposed, independently, the meteoric theory of the sun's heat, and in 1854 Professor William Thomson applied his admirable mathematical powers to the development of the theory; but six years previously the subject had been handled in a masterly manner by Mayer, and all that I have said on this subject has been derived from him. When we consider the circumstances of Mayer's life, and the period at which he wrote, we cannot fail to be struck with astonishment at what he has accomplished. Here was a man of genius working in silence, animated solely by a love of his subject, and arriving at the most important results some time in advance of those whose lives were entirely devoted to Natural Philosophy. It was the accident of bleeding a feverish patient at Java in 1840 that led Mayer to speculate on these subjects. He noticed that the venous blood in the tropics was of a much brighter red than in colder latitudes, and his reasoning on this fact led him into the laboratory of natural forces, where he has worked with such signal ability and success. Well, you will desire to know what has become of this man. His mind gave way; he became insane, and he was sent to a lunatic asylum. In a Biographical Dictionary of his country it is stated that he died there; but this is incorrect. He recovered; and, I believe, is at this moment a cultivator of vineyards in Heilbronn.

June 20.

While preparing for publication my last course of lectures "On Heat," I wished to make myself acquainted with all that Mayer had done in connection with this subject. I accordingly wrote to two gentlemen who above all others seemed likely to give me the information which I needed. Both of them are Germans, and both particularly distinguished in connection with the Dynamical Theory of Heat. Each of them kindly furnished me with the list of Mayer's publications, and one of them was so friendly as to order them from a bookseller, and to send them to me. This friend, in his reply to my first letter regarding Mayer, stated his belief that I should not find anything very important in Mayer's writings; but before forwarding the memoirs to me he read them himself. His letter accompanying the first of these papers, contains the following words:—"I must here retract the statement in my last letter, that you would not find much matter of importance in Mayer's writings: I am astonished at the multitude of beautiful and correct thoughts which they contain;" and he goes on to point out various important subjects, in the treatment of which Mayer had anticipated other eminent writers. My second friend, in whose own publications the name of Mayer repeatedly occurs, and whose papers containing these references were translated some years ago by myself, was, on the 10th of last month, unacquainted with the thoughtful and beautiful essay of Mayer's, entitled "Beiträge zur Dynamik des Himmels;" and in 1854, when Professor William Thomson developed in so striking a manner the meteoric theory of the sun's heat, he was certainly not aware of the existence of that essay, though from a recent number in *Macmillan's Magazine* I infer that he is now aware of it. Mayer's physiological writings have been referred to by physiologists—by Dr. Carpenter, for example—in terms of honourable recognition. We have hitherto, indeed, obtained fragmentary glimpses of the man, partly from physicists and partly from physiologists; but his total merit has never yet been recognised as it assuredly would have been had he chosen a happier mode of publication. I do not think a greater disservice could be done to a man of science, than to overstate his claims; such overstatement is sure to recoil to the disadvantage of him in whose interest it is made. But when Mayer's opportunities, achievements, and fate are taken into account, I do not think that I shall be deeply blamed for attempting to place him in that honourable position which I believe to be his due.

Here, however, are the titles of Mayer's papers, the perusal of which will correct any error of judgment into which I may have fallen regarding their author. "Bemerkungen über die Kräfte der unbelebten Natur," Liebig's *Annalen*, 1842, vol 42, p. 231; "Die Organische Bewegung in ihrem Zusammenhange mit dem Stoff-wechsel;" Heilbronn, 1845; "Beiträge zur Dynamik des Himmels," Heilbronn, 1848; "Bemerkungen über das Mechanische Equivalent der Wärme," Heilbronn, 1851.

Royal Institution of Great Britain.—General Monthly Meeting, Monday July 7, 1862. William Pole, Esq., M.A. F.R.S., Treasurer and Vice-President, in the Chair. William Radford, M.D., and William Ranger, Esq., C.E., were elected Members of the Royal Institution. The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

1084. Alfred Vincent Newton, Chancery Lane, London, "Improvements in the manufacture of blasting powder." —A communication from Frederick Wynans and Prosper Esselens, Ixelles, Belgium.—Petition recorded April 15, 1862.

1223. Enrico Angelo Ludovico Negretti and Joseph Warren Zambra, Hatton Garden, London, "Improvements in the construction of mercurial minimum thermometers." —Petition recorded April 25, 1862.

1238. Alfred Vincent Newton, Chancery Lane, London, "Improvements in the manufacture of hollow glass ware." —A communication from James Seaman Atterbury, Thomas Bakewell Atterbury, and James Reddick, Pittsburg, Alleghany, United States. — Petition recorded April 26, 1862.

1469. George Henry Birkbeck, Southampton Buildings, Chancery Lane, London, "Improvements in apparatus for consuming smoke."—A communication from M Etienne Deshurand and Madame Anais Lemercier, Paris.

1473. Charles Attwood, Taw Lan Ironworks, Durham, "Improvements in the production or manufacture of steel and iron of a steely quality."

1475. Isham Baggs, Cambridge Terrace, Middlesex, and William Simpson, Tovil Upper Mills, Maidstone, Kent, "Improvements in treating straw, Spanish grass, and other vegetable fibres, in preparing a bleaching agent for vegetable fibres, and in recovering and treating an alkali resulting from the treatment of the said fibres, and in apparatuses employed therein."

1483. Christopher Binks, Parliament Street, Westminster, "Improved methods of, and apparatus for, treating linseed and other oils and fats."

1523. James Taylor, Fenchurch Buildings, Fenchurch Street, London, "Improvements in abstracting heat from liquids and aëriform fluids, and in apparatus employed therein, and for other purposes."

1533. Macedo Alexandre Le Brun Virloy, Paris, "Improvements in drying and carbonising wood, peat, and other fuel."

1564. George Thomas Livesey, South Metropolitan Gas Works, Old Kent Road, Surrey, "Improvements in purifying illuminating gas, and in treating the products obtained in the various processes of purification."

1652. William Kirby Sullivan, Upper Leeson Street, Rathmines, Dublin, "Improvements in the preservation of stone, plaster, cement, and other like matters, the invention being likewise applicable to the manufacture of artificial stone, and to the fixation and production of colours on and in the body of stone, plaster, or cement." —Petitions recorded May 31, 1862.

1575. Robert Michael Letchford, Three Colts Lane, Bethnal Green, London, "An improvement in the manufacture of matches."

1608. William Blackmore, Foynes, Limerick, and Henry Lamb, Ennis, Clare, Ireland, "Improvements in burning limestone, and generating steam."

1642. Theodore Vicomte de Veye, Passage des Petites Ecuries, Paris, "A coating intended to protect iron from rust, and to preserve wood, cloth, paper, and pasteboard used for packing or roofing."

1662. Carroll Eugene Gray, Great Suffolk Street, Southwark, Surrey, "Improvements in apparatus for extracting, rendering, receiving, purifying, cooling down, and delivering oleaginous and fatty matters or other material treated by steam pressure for extraction."

1670. Goldsworthy Gurney, Bude, Cornwall, "Improvements in apparatus for production and application of artificial light."

1704. James Verity, Carlton Road, Kentish Town, London, "An improved composition for coating and preserving walls or other exposed surfaces."

1716. Alfred Ford, Priory, Battersea, Surrey, "An improved method of protecting beer and other fluids from the direct action of atmospheric air."

1718. John Keeling, Reading, Berkshire, "Improvements in apparatus for the manufacture of gas."

1746. John Ingham and William Pickard Wood, Valley Dye Works, Bradford, Yorkshire, "Improvements in preparing colouring matters for dyeing and printing."

1631. Henry Potter Burt, Charlotte Row, Mansion House, London, "Improvements in protecting wooden posts from decay, more particularly applicable to posts for supporting electric telegraph wires."

1637. Alfred Gilbey, Oxford Street, London, "Improvements in the construction of packing cases or boxes for holding bottles either full or empty."

1707. William Richard Jeune, Flower Terrace, Campbell Road, Bow, London, "Improvements in the manufacture of fabrics suitable to be used as substitutes for solid leather."—Petitions recorded June 6, 1862.

1723. Arthur Knowles, Birstal Dye Works, Birstal, near Leeds, Yorkshire, "Improvements in apparatus for washing extracted wool and other fibre."—Petitions recorded June 9, 1862.

1727. John Anthony Pols, Nye's Wharf, Grand Surrey Canal, Old Kent Road, Surrey, "An improved method of refining oils."

1729. George Thomas Jourdain, St. Paul's Terrace, Canonbury, London, "Improvements in treating cocoanut oil."

1743. Balthasar Wilhelm Gerland, Newton-le-Willows, Lancashire, "Improvements in the manufacture of sulphate of copper, and in obtaining metals from the material used in such manufacture."

1774. Richard Archibald Brooman, Fleet Street, London, "Improvements in coaking ovens, in collecting and utilising the products resulting from the distillation or carbonisation of coal and other matters producing coke, and in apparatus employed therein."—A communication from Charles Claude Philibert Nicolas Pernolet, Rue de Trévise, Paris.

1776. Robert Hicks, Kensington Park Terrace, London, "Improvements in the manufacture or preparation of paints, pigments, and colours."—Petitions recorded June 14, 1862.

1780. George Henry Birkbeck, Southampton Buildings, Chancery Lane, London, "Improvements in the construction of presses for extracting liquids from various substances."—A communication from Jean Joseph Requier and Eugène Genestal, Paris.

Notices to Proceed.

1231. Squier Cheavin and George Cheavin, Boston, Lincolnshire, "Improvements in filtering and purifying water, and in apparatus employed therein."—Petition recorded April 26, 1862.

1350. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the manufacture and production of minium or red lead."—A communication from Charles Louis Pierre Burton, Rue St. Sébastien, Paris.

1352. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the manufacture of soda and potash, and of their carbonates."—A communication from Charles Louis Pierre Burton, Rue St. Sébastien, Paris.—Petitions recorded May 6, 1862.

1371. William Gossage, Widnes, Lancashire, "Certain improved apparatus to be used in the manufacture of soap." —Petition recorded May 7, 1862.

325. Hugh Adams Silver, Silvertown, Essex, "Improvements in the manufacture of trays, cases, and other similar articles, and bottles in ebonite, vulcanite, or other hard india-rubber."—Petitions recorded February 7, 1862.

423. Edward Thomas Hughes, Chancery Lane, London, "An improved method of and apparatus for collecting

the gases given off from furnaces." A communication from Emil Langen, Siegburg, Prussia.—Petition recorded February 17, 1862.

471. William Henry Ross, Liverpool, "Improvements in the manufacture of sugar." A communication from Edward Beanes, Havana, Island of Cuba.

495. Lewis Davis, Gloucester Gardens, Hyde Park, and Frederick Major Parkes, Marylebone, London, "An improvement in the production or manufacture of gas for lighting and heating."

578. Thomas Tillam, Church Street, Deptford Green, Kent, "An improved method of purifying gas."—Petition recorded March 3, 1862.

424. Thomas Birdsall and James Birdsall, Leeds, Yorkshire, "Improvements in preparing hides or skins for tanning."—Petition recorded February 17, 1862.

428. Richard Watkins, Lower Belgrave Place, Pimlico, London, "Improvements in oil and spirit lamps, and in the means of producing light therein, parts of which improvements are applicable to lamps generally."

444. William Davis, Spencer Road, Stoke Newington, London, "Improvements in increasing the illuminating effect of coal-gas and other gases."—Petitions recorded February 19, 1862.

451. Emil Moritz Stoehr, Manchester, "Improvements in the manufacture of manganese, and in the combinations of manganese with other metals."—A communication from Oscar Eugen Prieger and Ferdinand Carl Prieger, Schloss Gereuth, near Eburn, Bavaria.—Petitions recorded February 20, 1862.

843. John Haworth, Southampton Street, Bloomsbury, London, "An improved method of conveying telegraphic messages and signals by means of electricity, without the intervention of any continuous artificial conductor."—Petition recorded March 27, 1862.

1473. Charles Attwood, Taw Lan Ironworks, Durham, "Improvements in the production or manufacture of steel and iron of a steely quality."—Petition recorded May 15, 1862.

CORRESPONDENCE.

The Nitro-prusside of Sodium Test for Strychnine.

To the Editor of the Chemical News.

Sir,—With all due deference to Professor Rodgers' letter which appears in last week's Chemical News, I beg to inform that gentleman that I am not aware of any error having been committed and circulated by me.

I unfortunately stated in my paper that it was "by chance" I used, as a test, a solution of what I considered the nitro-prusside of sodium, and, therefore, now beg to correct myself by observing that it was not altogether by accident, for the fact is I have been studying a series of new tests for the alkaloids for some time past; but having said so, Professor Rodgers, because for some reason or other he failed to make it answer, seizes upon, and takes it for granted, seeing I have succeeded, that I must have used the ferridcyanide of potassium by mistake; in disproof of which it is hardly necessary for me to remind the learned Professor that the ferridcyanide will never detect sulphur, whereas this solution which I made a year or so ago ostensibly for that purpose, readily does so by the intense purple produced with liquids containing the smallest particle of a sulphuret.

Happening at the time I made the solution in question to have reserved some of the ruby red crystals of the nitro-prusside, I have just made an experiment with them also, and I have proved, most unfortunately for my "critic," that he is sadly in error in saying that there is no reaction whatever with strychnia! . . . .

Of course there is, as Dr. Letheby observes, a right and a wrong way of using, as well as making the test, about which I have experienced no difficulty. Professor Rodgers therefore, having taken upon himself to criticise my paper without sufficient grounds for so doing, must be held responsible for the apparent injustice he has done me. . .

Whatever I contribute is done in truth and soberness, as a matter of fact; neither am I quite so incautious and inexperienced a person as Professor Rodgers would make it appear.

Those who know me best, know also that I am not given to put forward impracticable projects. If, however, any gentlemen require it, I shall have much pleasure in furnishing a formula for the best mode of preparing the test with the certainty of result ascribed by me.—I am, &c.

John Horsley, F.C.S.

Cheltenham.

Blue Ammoniacal Vapours.

To the Editor of the Chemical News.

Sir,—It is quite clear that Mr. Williams and I shall never agree about the colour of hydrochloric acid and ammonia vapours, and I therefore see no use in continuing the dispute. Your readers, too, have no doubt made up their minds each in his own way, and do not care to hear more on the subject. I am, of course, excessively stupid in not seeing just what Mr. Williams says I ought to see, and in seeing that which he says I ought not to see; and very unfortunate in never having had the opportunity of studying under such a master. I can only thank him for his efforts to enlighten me, and wish him better success another time.—I am, &c.

F. C. S.

Blue Ammoniacal Vapours.

To the Editor of the Chemical News.

Sir,—In your impression of my letter on "Bluish Ammoniacal Fumes" a slight error in punctuation quite alters the intended meaning of one sentence. The mistake I suspect was my own, and not your compositor's, as I put in the punctuation very hurriedly after the whole of the letter was written.

The sentence stands thus—"The bluish vapours, the colour of which is compounded of blue and white, would, if seen against a blue sky, appear very faintly white if they were of a pure blue, the same as the sky itself, and quite transparent;" etc. It should be—"The bluish vapours, the colour of which is compounded of blue and white would if seen against a blue sky appear very faintly white; if they were of a pure blue the same as the sky itself, and quite transparent, they would not be visible as a distinct body, but would merely intensify the apparent colour of the sky itself at the part which they overlaid."—I am, &c.

W. Mattieu Williams.

Hall Road, Handsworth, July 7.

ANSWERS TO CORRESPONDENTS.

A Reader.—Let some of the suspected spirit of nitre drop on filtering paper, and allow it to evaporate spontaneously. If it has been prepared with methylated spirit, a smell of wood-spirit will remain.

James C.—Taunate of alumina is prepared by triturating in a mortar equivalent proportions of freshly precipitated alumina and tannic acid. The whole is then to be washed and allowed to dry spontaneously. It is easily suspended in mucilage, in syrup, or in glycerine; and can also be exhibited in the form of an electuary.

A. B. C.—Crystals of sulphate of soda having their forms perfect and surfaces unbroken, will remain without any efflorescence if they be protected from external violence.

Q. P. R.—Cadmium can be easily separated from zinc by dissolving in sulphuric acid, diluting and precipitating with sulphuretted hydrogen. Sulphide of cadmium will be precipitated.

Amateur.—We will inquire and answer by post.

THE CHEMICAL NEWS.

VOL. VI. No. 137.—July 19, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the New Metal Thallium, by M.* A. LAMY.

ON examining, three months ago, with MM. Kirchhoff and Bunsen's spectrum apparatus, a specimen of selenium prepared by my brother-in-law, M. Fred. Kuhlmann, from the deposits in the chambers in which sulphuric acid was made by the combustion of pyrites, I perceived a sharply-defined green line which I had not observed in any of the numerous simple bodies or mineral compounds which I had studied. I was not then aware that an English chemist, Mr. W. Crookes, had not only discovered the same green line under almost analogous circumstances, but had given the name of *thallium* to the new element, from the Greek word θαλλος, or Latin *thallus*, frequently employed to express the rich tint of young and vigorous vegetation. Mr. Crookes, with great skill, described several of the reactions of the element, which he considered as a metalloid, probably belonging to the sulphur group; but the small quantity of substance did not permit him to isolate this element and recognise its true nature.†

We have endeavoured to isolate the new body by seeking for it in the deposits from the leaden chambers whence the selenium had been extracted, which gave us in the spectroscope the characteristic green line. This line has naturally served us as a guide, and has enabled us to prepare perfectly definite crystalline compounds, whence we have extracted thallium,—the first time with the assistance of an electric battery.

Properties of Thallium.—Thallium has all the characters of a true metal, and, in most of its physical properties, greatly resembles lead. Not quite so white as silver, it possesses a brilliant metallic lustre when freshly cut. It appears yellowish when rubbed against a hard body; but this tint is doubtless due to oxidation, for the metal precipitated by a battery from an aqueous solution, or fused in a current of hydrogen, is white, with a bluish grey tinge, which resembles aluminium.

Thallium is very soft, and very malleable; it can be easily scratched by the nail, and cut with a knife. It marks paper, leaving a yellowish streak. Its density (11·9) is a little higher than that of lead. It fuses at 290° C., and volatilises at a red heat. Lastly, thallium has a great tendency to crystallise, for the ingots obtained by fusion crackle like tin when they are bent. But the physical property, *par excellence*, of thallium,—that which, according to the beautiful researches of MM. Kirchhoff and Bunsen, characterises the metallic element,—that which led to its discovery,—is the property which it possesses of communicating to the pale gas-flame a green colour of great richness, and to the spectrum of this flame a single green ray as distinct and as sharply defined as the yellow ray of sodium, or the red ray of lithium. On the micrometric scale of my spectroscope, this ray occupies the division 120·5, that of sodium being at 100. The slightest portion of thallium, or of one of its salts, gives the green line with such brilliancy that it seems white. The fifty-millionth part of a gramme can, according to my calculations, be recognised in a compound.

Thallium tarnishes rapidly in the air, becoming covered with a thin pellicle of oxide, which preserves the rest of the metal from alteration. This oxide is soluble, is decidedly alkaline, and has a taste and smell similar to potash. By this characteristic, as well as by its optical properties, thallium approaches the alkaline metals.

Thallium is attacked by chlorine, slowly at the ordinary temperature, rapidly at a temperature above 200° C. The metal then melts, becomes incandescent under the action of the gas, and gives rise to a yellowish liquid, which solidifies on cooling to a mass of a little paler colour.

Iodine, bromine, sulphur, and phosphorus can also combine with thallium, forming iodides, bromides, sulphides, and phosphides.

Recently-prepared thallium preserves its metallic lustre in water. It does not appear to decompose this liquid at the temperature of ebullition, but, by the aid of an acid, it separates its elements, disengaging hydrogen.

Sulphuric and nitric acids are those which attack thallium easiest, especially by the aid of heat. Hydrochloric acid even boiling dissolves it very difficultly. Under these circumstances, there form white soluble salts, sulphate, and nitrate, crystallising readily, and a slightly soluble chloride, but capable also of crystallising.

The chloride formed by the direct action of chlorine or by *aqua regia* is deposited from its aqueous solution in the form of magnificent yellow plates, which appear to belong to the rhombohedral system.

Zinc precipitates thallium from its sulphate and nitrate solutions; the new metal deposits in brilliant crystalline plates.

Hydrochloric acid and protochlorides give, with the same solutions, a white precipitate of chloride of thallium resembling chloride of silver, but slightly soluble in water; otherwise, very little soluble in ammonia, and inalterable by light.

Hydro-sulphuric acid has no action on pure neutral or acid solutions; but if they are alkaline a voluminous black precipitate of sulphide of thallium is produced, which readily settles to the bottom of the vessels, and is insoluble in an excess of precipitant.

Finally, potash, soda, and ammonia, do not displace

* Communicated by the author, having been read before the Académie des Sciences, on Monday, June 23.

† I obtained the element in a pure metallic state, investigated its properties, and exhibited to several friends as early as January last. (See my paper read before the Royal Society, June 19, 1862.)—W. C.

oxide of thallium in combination with sulphuric and nitric acids.

Natural State and Extraction.—Thallium cannot be considered as very rare in nature. It exists, indeed, in many kinds of pyrites, which are used at the present time in large quantities, principally for the manufacture of sulphuric acid. I may especially mention Belgian pyrites from Theux, Namur, and Philippeville. I have also found it in mineralogical specimens from Nantes and Bolivia, in America.

Strictly speaking, thallium might be prepared from these pyrites; but it is much easier to prepare it by using the deposits from the lead chambers, where it accumulates in relatively large quantities during the manufacture of sulphuric acid. It is from these thalliferous deposits that I have extracted, by a method given in my memoir, the chlorides of thallium which formed the starting-point of the study which I have made of the new metal and its compounds.

As to the metal itself, it may be reduced from one of its saline combinations either by the decomposing action of an electric current, or by precipitation with zinc, or by reduction with charcoal at a high temperature. The chlorine may also be separated from its chlorides by potassium or sodium, under the influence of heat; in this latter case the reaction is very energetic.

The small ingot, weighing fourteen grammes, which I had the honour of exhibiting to the Academy, was entirely isolated by a battery of a few Bunsen elements, first from the chlorides originally obtained, and then from the crystallised sulphate formed directly by the solution of this thallium in pure sulphuric acid.

In concluding my memoir, I wish the Academy to understand that I do not pretend to lay before them a complete research on thallium. My object has chiefly been to show the new metal and some of the principal salts which it forms. In a subsequent communication I will endeavour to fill up some of the gaps at present in its history.

A New Metal in the Native Platinum of Rogue River, Oregon, by C. F. CHANDLER, *Professor of Chemistry at Union College.*

IN examining native platinum from the above locality, more than a year ago, I became convinced of the probable existence of a hitherto unobserved metal. I have deferred publishing my observations, hoping to obtain material for a more complete examination; in this I have thus far been disappointed.

The quantity of platinum examined amounted to only a few grammes. It was digested with hydrochloric acid to remove impurities, and the solution thus obtained was subjected to the ordinary routine of qualitative analysis.

A brown precipitate was produced by hydrosulphuric acid, which dissolved readily in hydrochloric acid on the addition of a crystal of chlorate of potassa. In this solution metallic zinc produced a precipitate which resembled metallic tin, obtained under similar circumstances. This precipitate dissolved readily in hydrochloric acid on the application of heat, but the solution thus obtained had no effect on a solution of protochloride of mercury ($HgCl$), and on cooling deposited a small quantity of minute crystals. To guard against error, these experiments were repeated two or three times on small portions of the original solution, always with the same result.

The chloride of this metal differs, therefore, from the protochloride of tin, in not reducing protochloride of mercury to calomel, and in being but slightly soluble in the cold.

On mentioning my observations to a friend, I was referred to Dr. F. H. Genth's announcement of a new metal, made in 1852,* of which I was not previously aware.

The metal observed by Dr. Genth occurred among grains of platinum from California. It was malleable; it fused readily on charcoal before the blowpipe, becoming covered with a coating of black oxide; it dissolved in borax to a colourless bead, which became opalescent on cooling; it was dissolved by hot hydrochloric acid, and by nitric acid; and its solution gave a brown precipitate with hydrosulphuric acid. It seems quite probable, therefore, that the metal which I have observed in the Rogue River platinum is identical with that observed by Dr. Genth.—*American Journal of Science.*

On the Analysis of Chrome Iron Ores, by Dr. F. A. GENTH.

IN No. 120 of the CHEMICAL NEWS I observe a request to Mr. C. L. Oudesluys to furnish the method he employs for analysing chrome ores. During the last two years I have made the majority of the analyses of chrome ores shipped from this country to Europe, and there can be no doubt that, the utmost care having been used in every instance, the results given were the true yield of the samples received within very narrow limits of the unavoidable errors of analysis. Permit me to point out the principal causes of the discrepancies between my own and the English analyses, in the hope to show where the blunder lies. I had intended to make a careful critical examination of all the methods used for analysing chrome ores, but many other engagements have compelled me to postpone this investigation. A few observations, however, made in a letter to Mr. Oudesluys about Mr. O'Neill's process of analysis, misconstructed or misunderstood, have been reproduced in No. 127 of the CHEMICAL NEWS. They require some explanation, in reference to which allow me to call your attention.

The varieties of chrome ores found in this country are very numerous, but few only furnish at present the material for regular shipments. The massive chrome ores, the so-called rock ores, are sometimes almost pure chromic iron, with little or no admixture, but generally more or less intimately intermixed with various varieties of serpentine, gymnite, nickelgymnite, pyrosclerite, kæmmererite, chlorite, talc, fuchsite, actinolite, chrysolite, dolomite, aragonite, magnesite, brucite, emerald nickel, &c. Sometimes these associates are so predominating that the ores require dressing before they are fit for use. Sometimes the foliated minerals, such as talc, fuchsite, &c., are so intimately mixed with the chromic iron that they are nearly worthless on account of their excessive toughness and the great difficulty and expense to reduce them to powder, although their yield of chromic acid (from 36 to 50 per cent.) might be considered sufficient. I am not aware that within the last year any rock ore in bulk has been shipped to Europe. The firm which controls the largest mines generally sends the rock ores pulverised, dressed, and mixed with about 50 per cent. of sand ores. All the other rock ore mines lie dormant at present, although the appearance of some is very

* *Proceedings of the Philadelphia Academy of Natural Science*, December, 1852.

favourable, and promises that they will probably furnish large quantities of ore when sufficiently developed.

By far the most important ores, as long as they can be furnished, are the sand or grain ores. They result from the decomposition and disintegration of chromiferous rocks, and are washed from the streams and the soil which contain them. When improperly washed they represent a collection of almost every mineral found in the neighbourhood. Besides chromic iron, which sometimes is obtained in beautiful octahedral crystals, I have observed magnetite, hematite, ilmenite, limonite, rutile, brookite, corundum, quartz, zircon in very fine crystals, actinolite, orthoclase, albite, several varieties of garnet, chrysolite, serpentine, talc, chlorite, &c. Most of these minerals can be separated very easily, but magnetite, limonite, and garnet occur in some of the washings in such large quantities that, on account of their higher specific gravity, the purification of such chrome ores is attended with the greatest difficulties, and is often impossible. A very remarkable fact is, that the same locality, if in washing the same care is always used, furnishes ores of the most uniform character, whilst a stream but a few rods distant frequently yields ores of an altogether different nature.

Unfortunately, the quantities furnished by many of the washings are very small, and a shipment of chrome ores is necessarily often made up from half-a-dozen or more localities, some yielding rich and others very poor ores. These are then packed in barrels, containing on an average from 900 to 1000 pounds each.

Whilst some of the shippers of chrome ores, agreeing therein with my opinion, consider it of the greatest importance to have every barrel emptied out, the material for one shipment thoroughly mixed together, and the uniform mixture barrelled again, after which samples taken from every barrel, by boring them with a long augur from the top to the bottom, and these samples thoroughly mixed in air-tight cans, are sent in for analysis,—others consider this practice too expensive and troublesome. I know that chrome ores have been and are being constantly shipped without knowing what the barrels contain; this with perfectly honest intentions, it being deemed sufficient to take an augur-full from each barrel; and the ores thus obtained, after being mixed together, are sent in for analysis. Bad as this practice may be of itself, there is still another which causes results absolutely unreliable, and which, I am sorry to say, is too frequently resorted to. The shippers of chrome ores are generally not the owners of the deposits, but purchase from the owners of the land or lessees who wash the ore. Since it sometimes requires the bulk of more than twenty tons to furnish one ton of clean ore, large quantities of tailings are accumulating Instances have come to my knowledge, when the purchaser's mode of sampling being known, large quantities of tailings have been passed off upon him as ore, by being placed in the barrels in such a manner that he would not be very likely to get any of them into his augur. Samples have been handed to me of such stuff sold as ore, which did not contain 10 per cent. of chromic iron. It is a matter of course that the manufacturers in Europe suspect the shippers of such trash, whilst in general these are perfectly ignorant of the fraud.

Even if we take it for granted that in many instances no dishonesty has been practised by the ore-washer, it is impossible to take a true average sample from ores which vary so much in their yield.

I have been subjected to a great deal of annoyance in consequence of my inability to make my analyses agree with the notions which sometimes the shippers had of their ores, and the entire disregard with which my advice to have the ores thoroughly mixed before sampling has been treated.

As already remarked, the ores of the same locality, if carefully cleaned, are very uniform in their character and yield. This observation has been made the basis to make up shipments of ores intended to yield on an average about 50 per cent. of chromic acid.

Allow me to quote a few instances of the trouble and annoyance I have suffered in reference to these matters: In August, 1860, I analysed a sample of ore made up of three lots yielding between 38 and 54 per cent. of chromic acid. I found 43·86 per cent.,—being about 7 per cent. less than expected. Another sample, analysed in November, 1860, made up of six different kinds of ore, yielding from 38 to 70 per cent. of chromic acid, should, according to my correspondent's calculation, have yielded over 50 per cent., whilst my result was 45·41. Another shipment, in December, 1860, made up of five different varieties of ore, yielding from 36 to 54 per cent., gave 40·28 per cent., instead of 50·5. Another sample, analysed in October, 1861, gave 39·08 per cent.; the per-centage calculated by the shipper was 52·37.

Another very striking illustration that it is impossible to sample ores correctly by the methods adopted by certain parties, is given by the following observations:—In October, 1861, I received for analysis a sample alleged to be the average of the ore of 125 barrels, which gave 44·38 per cent. of chromic acid. For reasons unknown to me this lot was not shipped, and last April I received an average (?) sample of the same yielding only 41·99 per cent.

These differences are really enormous, especially if you bear in mind that analyses of the same sample, which I have frequently made, never varied over 0·25 per cent. of chromic acid.

Parties abroad interested in the purchase of chrome ore should use the utmost care to guard against losses, no matter from what cause, in forming their connections here with none but parties scientifically competent and otherwise careful and fully reliable.

However badly the sampling may be done by some shippers in this country, I know that it is sometimes done worse in England. If the ores were thoroughly mixed, a sample from any of the barrels might be sufficient, and certainly would give results within 1 per cent. of the truth. When one shipment contains ores varying much in their yield, all the barrels ought to be emptied out and well mixed before the sample is taken; instead of which, some parties take a sample from every fifth or tenth barrel, whilst others pick out the poorest, &c.

I have dwelt thus much upon this subject, because I consider it the principal source of the discrepancies in the analyses.

Another cause, although of less importance, results from the fact that the ores are sometimes analysed dry, sometimes wet. As I receive them for analysis they contain between 0·5 and 12 per cent. of moisture, but generally between 1 and 3 per cent. They are frequently sent in tight tin cans, to prevent the moisture from escaping; sometimes, however, perfectly dry. Some of the shippers send their ores always dry; others appear not to have as yet adopted a particular rule; but I have had objections when stating in my report that the

analysis had been made of dry ore, and was requested to drop remarks in reference to its condition.

Another cause of the discrepancies I find in the fact that such analyses are generally not made by those chemists who would do it best, but by those who do it cheapest, or those who are interested in the results, or who think their methods are good enough for "commercial" analyses, and who do not care to take the trouble to obtain absolutely correct results; moreover, since the yield on a large scale agrees better with their analyses. Shippers of ores in general, not only of chrome ores, but also of gold, silver, lead, copper, nickel, and zinc ores, frequently complain of English assays; they certainly should not tamely submit when their interests are placed into the hands of persons often fully incompetent.

I pass over to the methods used for analysing chrome ores.

Of that of Mr. O'Neill's I regret to say that it did not give me the promised results. With the greatest care I have made three experiments according to his method, published in No. 123 of the CHEMICAL NEWS, and after the preliminary fusion with bisulphate of potash, &c., I have fused the oxides with exactly the quantities of carbonate of soda and chlorate of potash as directed. In every instance I found a small quantity of the chrome unoxidised, but partly soluble in chlorhydric acid. Even in an experiment, which I have made with the insoluble salt, obtained by fusing pure chromic oxide with bisulphate of potash and washing out with water, I was not able to convert all the chromic oxide into chromic acid by the mixture of chlorate of potash and carbonate of soda. Although this mixture acts upon the chromic oxide very rapidly, it does not completely. This is the more to be regretted, since the only process which I found would give fully reliable results, is extremely slow and tedious. It is a slight modification of that of T. S. Hunt's, Esq. (*Sill. Am. Journ.* [2] v. 418), of which this excellent chemist says that it, "being free from any sources of error, yields very accurate results."

Of the chrome ore reduced to an impalpable powder I put 0·5 gramme in a platinum crucible (that which I use is two inches high, nearly $1\frac{3}{4}$ inches wide, and holds 52 grammes of water), and place upon it 6 grammes of pure fused bisulphate of potash, and heat with the greatest care for about 15 minutes, at a temperature scarcely above the fusing point of the bisulphate; then the heat is gradually raised, but not higher than to make the bottom of the crucible red hot, and kept at this temperature from 15 to 20 minutes. I never permit the mass to rise to half the height of the crucible. (If the fusion with bisulphate of potash is done so rapidly, a portion of the analysis is very apt to be lost by spattering from the escape of sulphurous acid, resulting from the oxidation of the ferrous oxide by the sulphuric acid.) The mass begins now to fuse quietly, and vapours of sulphuric acid begin to go off more freely, when I allow it to be at red heat for about twenty minutes, and then raise the heat as high as necessary to drive off the second equivalent of sulphuric acid, and even to decompose a portion of the sulphates of ferric and chromic oxides. To the fused mass I add about three grammes of pure carbonate of soda, and fuse the mixture, and then, by degrees, keeping the temperature for about one hour at dull red heat, about the same quantity of saltpetre; then I heat for fifteen minutes at a bright red heat. The fused mass is dissolved in boiling water, filtered whilst boiling, and washed with boiling water. The insoluble residue, containing the greater portion of the silicic acid, titanic acid, and alumina, the sesquioxide of iron, zirconia, and—if the fusion has been conducted at a temperature sufficiently high to convert the saltpetre into caustic potash, and the above precautions have been used—all the magnesia, is always redissolved in dilute warm chlorhydric acid. which generally dissolves it readily and completely, and rarely leaves undecomposed ore behind; but if so, I invariably fuse this residue in a small crucible as before, adding, after the separation of the insoluble portion, the solution containing the small quantity of chromic acid to the first filtrate. (The certainly less troublesome method, to deduct the insoluble portion from the original weight, which the Baltimore chemist makes use of, is a very bad one; such residues have never the composition of the original ore.) The filtrate contains the whole quantity of chrome as chromic acid, sometimes a trace of manganic acid, small quantities of silicic acid, alumina, and rarely titanic acid. To this solution I add an excess of nitrate of ammonia, and evaporate over a water bath nearly to dryness, and until all the liberated ammonia has been expelled. The precipitate, remaining on addition of water, contains the silicic acid, titanic acid, alumina, and manganic oxide, which had gone into solution with the chromic acid; it is filtered off, and the filtrate made strongly acid with sulphurous acid, carefully heated to boiling, precipitated with a slight excess of ammonia, boiled for a few minutes and filtered. I formerly acidulated the chromic acid solution by chlorhydric acid, and then added sulphurous acid, but I have several times observed that, although an excess of sulphurous acid had been used, a small portion of the chromic acid escaped reduction, the filtrate from the ammonia precipitate being yellow. I have in vain tried to find the reason for this singular behaviour. Since I use sulphurous acid only, I never have been troubled with anything similar.

It is exceedingly difficult to wash out the chromic oxide; it succeeds best in the following way:—After the precipitate has settled the clear liquid is passed through the filter, then boiling water is added to the precipitate, and after settling the supernatant liquid filtered, then the precipitate is put on the filter, and washed twice or three times with boiling water; it is then washed back again into the dish and boiled with water, until the little lumps which clog together are completely broken up, and then filtered, and this operation repeated until the wash-waters do not show the presence of any sulphates by chloride of barium. The precipitate is then dried and burned. No matter how well it may have been washed, it almost invariably contains minute quantities of alkalies, in the presence of which a little chromic oxide is converted into chromic acid. I therefore put the ignited precipitate into a dish, boil with water, add a few drops of sulphurous acid, precipitate by ammonia, filter, wash, dry, ignite, and weigh.

In this manner I get the chromic oxide quite pure, and repeated analyses of it have shown it to be quite free from silicic acid, alumina, or magnesia; my analyses of the same sample never vary 0·25 per cent. of chromic acid.

This cannot be said of any other method, certainly not of Mr. O'Neill's; that he himself is not satisfied with the correctness of it, he admits by saying, "I usually make two analyses, and reject them if they show a difference of more than 2 per cent. of oxide of chromium." This remark would be perfectly superfluous if such differences would not from time to time occur;

and if I take it for granted that Mr. O'Neill is a very careful analyst, in whose hands good methods always produce the true result, I must come to the conclusion that his method cannot be a good one, even had I not been able to point out where he loses a portion of the chromic oxide. From a commercial point of view, 2 per cent. of chromic oxide = 2·6 per cent. of chromic acid, representing a difference of nearly four dollars per ton.

I am perfectly satisfied of the correctness of my method, and nobody can use more care than I do to obtain fully reliable results. My analyses have frequently been corroborated in Europe, when exactly the same sample was analysed by careful chemists. Permit me to give you one or two out of many instances:—

Last year a lot of ore shipped to Trieste, yielding by my analysis 64·95 per cent., gave there 65 per cent.

Without knowing from which locality they came, I analysed within the last two years three lots of ore, which, as I afterwards learned, came from the same washing. I found 62·88, 63·26 and 62·87 per cent. of chromic acid. A portion of the last sample was analysed by Mr. O'Neill, who found 53·84 per cent., and by Mr. E. Hautfeuille, of Paris, who found it to yield 63·3 per cent. chromic acid. A further comment on such differences is needless. I could give you much more information on this subject if I had time at present; I may do so in another communication.

108, Arch Street, Philadelphia, June 23.

TECHNICAL CHEMISTRY.

On a Regenerative Gas Furnace, as applied to Glass-houses, Puddling, Heating, &c., by Mr. C. William Siemens, *of London.**

(*Continued from page* 20.)

The most important step in the development of the regenerative furnace has been the complete separation of the fire-place or gas producer from the heating chamber or furnace itself. When a uniform and sufficient supply of combustible gas is ensured, it can evidently be heated just like the air, by being passed through a separate regenerator before reaching the furnace, whereby its heating power is greatly increased. The difficulty of maintaining a uniform flame in the furnace is thereby certainly removed, and there is no longer any necessity for keeping the flame always in the same direction through the furnace, since the gas can be introduced with equal facility at each end of the heating chamber in turn, and the periodical change of direction of the flame through the furnace tends only to make the heat more uniform throughout; whereas in the previous plan of employing solid fuel for heating in the furnace, the relative position of the fire-place and heating chamber being fixed and unchangeable, required the direction of the flame to be kept always the same, unaltered by the reversal of currents through the regenerators. The new plan of a separate gas producer has now been successfully carried out in practice, and there are already a considerable number of the regenerative gas furnaces in satisfactory operation in this country and on the Continent, applied to glass-houses, iron furnaces, &c. In the neighbourhood of Birmingham, at Messrs. Lloyd and Summerfield's glassworks, a flint-glass furnace constructed upon this plan has now been in continuous operation for nearly twelve months, and affords a good opportunity of ascertaining the consumption of fuel of the regenerative furnace as compared with the previous furnace performing the same work. At the glassworks of Messrs. Chance Brothers and Co., near Birmingham, the regenerative gas furnace has been under trial for the same length of time, and has latterly been adopted for the various purposes in crown and sheet glass making upon a very large scale. Messrs. James Russell and Sons, Crown Tube Works, Wednesbury, are also applying the furnace to the delicate operation of welding iron tubes, and, in a short time, will probably employ no solid fuel for any furnaces at their works. Another flint-glass furnace erected by Messrs. Osler in Birmingham, and several puddling furnaces erected by Messrs. Gibbs Brothers at Deepfields, and by Mr. Richard Smith at the Round Oak Iron Works, are amongst the latest applications of the regenerative gas furnace, the designs having in all cases been furnished by the writer, and carried out under his brother's immediate superintendence.

The gas producers are entirely separate from the furnace where the heat is required, and are made sufficient in number and capacity to supply several furnaces. The fuel, which may be of the poorest description, such as slack, coke dust, lignite, or peat, is supplied at intervals of from six to eight hours through covered holes, and descends gradually on an inclined plane, which is set at an inclination of from 45° to 60°, according to the nature of the fuel used. The upper portion of the incline is made solid, being formed of iron plates covered with fire-brick; but the lower portion is an open grate, formed of horizontal flat steps. At the foot of the grate is a covered water trough, filled with water up to a constant level from the small feeding cistern, supplied by a water pipe with a ball tap. The large opening under the water trough is convenient for drawing out clinkers, which generally collect at that point. Small stoppered holes at the front and top of the producer are provided to allow of putting in an iron bar occasionally to break up the mass of fuel and detach clinkers from the side walls. Each producer is made large enough to hold about ten tons of fuel in a low incandescent state, and is capable of converting about two tons of it daily into a combustible gas, which passes off through an opening into the main gas flue leading to the furnaces.

The action of the gas producer in working is as follows:—The fuel descending slowly on the solid portion of the inclined plane, becomes heated and parts with its volatile constituents, the hydrocarbon gases, water, ammonia, and some carbonic acid, which are the same as would be evolved from it in a gas retort. There now remains from 60 to 70 per cent. of purely carbonaceous matter to be disposed of, which is accomplished by the slow current of air entering through the grate producing regular combustion immediately upon the grate; but the carbonic acid thereby produced, having to pass slowly on through a layer of incandescent fuel, from three to four feet thick, takes up another equivalent of carbon, and the carbonic oxide thus formed passes off with the other combustible gases to the furnace. For every cubic foot of combustible carbonic oxide thus produced, taking the atmosphere to consist of one-fifth part by volume of oxygen and four-fifths of nitrogen, two cubic feet of incombustible nitrogen pass also through the grate, tending greatly to diminish the richness or heating power of the gas. Not all the carbonaceous portion of the fuel is, however, volatilised on such disadvantageous terms; for the water trough at the foot of the grate, absorbing the spare heat from the fire, emits steam

* Read before the Birmingham Institution of Mechanical Engineers.

through the small holes under the lid; and each cubic foot of steam in traversing the layer of from three to four feet of incandescent fuel is decomposed into a mixture consisting of one cubic foot of hydrogen, and nearly an equal volume of carbonic oxide, with a variable small proportion of carbonic acid. Thus, one cubic foot of steam yields as much inflammable gas as five cubic feet of atmospheric air; but the one operation is dependent upon the other, inasmuch as the passage of air through the fire is attended with the generation of heat, whereas the production of the water gases, as well as the evolution of the hydrocarbons, is carried on at the expense of heat. The generation of steam in the water trough being dependent on the amount of heat in the fire, regulates itself naturally to the requirements, and the total production of combustible gases varies with the admission of air. And since the admission of air into the grate depends in its turn upon the withdrawal of the gases evolved in the producer, the production of the gases is entirely regulated by the demand for them. The production of gas may even be arrested entirely for twelve hours without deranging the producer, which will begin work again as soon as the gas valve of the furnace is reopened, since the mass of fuel and brickwork retain sufficient heat to keep up a dull red heat in the producer during that interval. The gas is, however, of a more uniform quality when there is a continuous demand for it, and for this reason it is best to supply several furnaces from one set of producers, so as to keep the producers constantly at work. The opening leading from each producer into the main gas flue can be closed by inserting a damper from above in case any one of the producers is required to be stopped for repairs, or because part of the furnaces supplied are out of work.

It is important that the main gas flue leading to the furnaces should contain an excess of pressure, however slight above the atmosphere, in order to prevent any inward draughts of air through crevices, which would produce a partial combustion of the gas, and diminish its heating power in the furnace, besides causing a deposit of soot in the flues. It is, therefore, necessary to deliver the gas into the furnace without depending upon a chimney draught for that purpose. This could easily be accomplished if the gas producers were placed at a lower level than the furnaces; but as that is generally impossible, the following plan has been adopted. The mixture of gases on leaving the producers has a temperature ranging between 300° and 400° F., which must, under all circumstances, be sacrificed, since it makes no difference to the result at what temperature the gas to be heated enters the regenerators, the final temperature being in all cases very nearly that of the heated chamber of the furnace, or say 2500° F. The initial heat of the gas is, therefore, made available for producing a plenum of pressure by making the gas rise about twenty feet above the producers, then carrying it horizontally twenty or thirty feet through the wrought iron tube, and letting it again descend to the furnace. The tube being exposed to the atmosphere causes the gas to lose from 100° to 150° of temperature, which increases its density from 15 to 20 per cent., and gives a preponderating weight to that extent to the descending column, urging it forwards into the furnace.

In setting out each individual furnace, the heating effect required, the quality of the fuel employed, and the particular nature of the process to be performed, have to be considered. The amount of heat required determines the capacity of the regenerators; and the gas regenerators require fully as large a capacity as the air regenerators, and sometimes even a greater. This would perhaps hardly be expected, but will be seen to be the case from the following considerations. The gases proceeding from the gas producers are a mixture of olefiant gas, marsh gas, vapour of tar, water and ammoniacal compounds, hydrogen gas, and carbonic oxide, besides nitrogen, carbonic acid, some sulphuretted hydrogen, and some bisulphuret of carbon. The specific gravity of this mixture averages 0·78, that of air being 1·00; and a ton of fuel, not including the earthy remnants, produces according to calculation nearly 64,000 cubic feet of gas. By heating these gases to 3000° F. their volume would be fully six times increased, but in reality a much larger increase of volume ensues in consequence of some important chemical changes effected at the same time. The olefiant gas and tar vapour are well known to deposit carbon on being heated to redness, which is immediately taken up by the carbonic acid and vapour of water, the former being converted into carbonic oxide and the latter into carbonic oxide and pure hydrogen. The ammoniacal vapours and sulphuretted hydrogen are also decomposed, and permanently elastic gases with a preponderance of hydrogen are formed. The specific gravity of the mixture is reduced in consequence of these transformations to 0·70, showing an increase of volume from 64,000 to nearly 72,000 cubic feet per ton of fuel, taken at the same temperature. This chemical change represents a large absorption of heat from the regenerator, but the heat is given out again by combustion in the furnace, enhancing the heating power of the fuel beyond the increase due to elevation of temperature alone.

The chemical transformation is also of importance in preventing "sulphuring," for it is believed that the sulphur in separating from its hydrogen takes up oxygen supplied by the carbonic acid and water, forming sulphurous acid, a firm compound, which is not decomposed on meeting with metallic oxides in the furnace. This view is so far borne out by experience that glass containing a moderate proportion of lead in its composition may be melted in open crucibles without injury, instead of requiring covered pots for the purpose, as in ordinary furnaces. In dealing with the highest quality of flint glass, however, it is found necessary to retain covered pots; but every other description of glass is melted in open pots. In all branches of glass manufacture saving of fuel is of relatively small moment as compared with the improvement effected in the colour and general quality of the glass by the use of the regenerative gas furnace, owing to the absence of dust and cinders and the higher degree of temperature which may with safety be maintained throughout the heating chamber.

These advantages of the regenerative gas furnace are of equal value in the case of puddling and welding iron.

The four regenerators are in this case arranged longitudinally underneath the puddling chamber, which may be of the usual form. In order to complete the combustion of the gas and air in passing through the comparatively short length of the puddling chamber, it is necessary to mix them more intimately than is requisite in large glass furnaces. For this purpose a mixing chamber is provided at each end of the puddling chamber, and the gas and air from the regenerators are made to enter the mixing chamber from opposite sides; the gas aperture is moreover placed several inches lower than the air aperture, so that the lighter stream of gas rises through the stream of air, while both are urged forward into the puddling chamber, and an intense and perfect combustion is produced. The mixing chambers are sloped towards the furnace, in order to drain them of

any cinders which may get over the bridge. The reversal of the current through the furnace is effected about every hour by reversing valves in the air and gas flues, the arrangement of which is exactly similar to that in the glass furnace. The supply of gas and air is regulated by throttle valves, and the draught through the furnace by the ordinary chimney damper.

This same arrangement, with obvious modifications, may be applied also to blooming and heating furnaces, the advantages in both cases being a decided saving of iron, besides an important saving in the quantity and quality of the fuel employed. The space saved near the hammer and rolls by doing away with fire-places, separate chimney stacks, and stores of fuel, is also a considerable advantage in favour of the regenerative gas furnace in ironworks. The facility which it affords for either concentrating the heating effect or diffusing it equally over a long chamber, by effecting a more or less rapid mixture of the air and gas, renders the furnace particularly applicable for heating large and irregular forgings, or long strips or tubes which have to be brought to a welding heat throughout. It has already been applied to a considerable extent in Germany for heating iron, having been worked out there under the direction of the writer's eldest brother, Dr. Werner Siemens, who has also contributed essentially to the development of the system. The furnaces at the extensive iron and engine works of M. Borsig, of Berlin, are being remodelled for the adoption of this system of heating, as have also been those at the Imperial factories at Warsaw.

Another important application of the regenerative gas furnace is as a steel melting furnace, in which the highest degree of heat known in the arts is required, presenting consequently the greatest margin for saving of fuel. This application of the regenerative gas furnace is indeed rapidly extending in Germany, but has not yet practically succeeded in Sheffield, where it was also tried. It is, however, in course of application at the Brades Steel Works, near Birmingham. The arrangement of the reversing valves and the air and gas flues is similar to that in the glass furnace previously described.

Other applications of the regenerative gas furnace are being carried out at the present time, among which may be mentioned one to brick and pottery kilns for Mr. Humphrey Chamberlin, near Southampton; for Messrs. Cliff, of Wortley, near Leeds; and for Mr. Cliff, of the Imperial Potteries, Lambeth; also to the heating of gas retorts at the Paris General Gas Works, and at the Chartered Gas Company's Works, London. The description already given, however, is sufficient to show the facility with which this mode of heating may be adapted to the various circumstances under which furnaces are employed. The important application of the regenerative system to hot blast stoves for blast furnaces, by Mr. E. A. Cowper, has already been separately communicated to this Institution (See Proceedings Inst. M.E., 1860, page 54).

The experience hitherto obtained with the regenerative mode of heating shows that it is attended with the greatest proportionate advantage in localities where good coal is scarce, but where an inferior fuel abounds. This applies most forcibly to the South Staffordshire district, where the best coal in lumps is worth 12s. 6d. per ton, whereas good slack can be had at 3s. or 4s. per ton. The question gains, moreover, in importance when it is considered that, according to the best authorities, the thick coal of the district is coming to an end, while millions of tons of coal dust have accumulated, of no present commercial value, which, on being converted into gas in the manner described by means of the gas producers, would acquire a heating value equal at any rate to the same weight of the best coal in the manner in which it is at present used. Considering, also, the proximity of the pits to the ironworks in this district, it may be suggested whether the gas producers, being of very simple construction, might not with advantage be placed near the banks of fuel above or even under ground, the gas being conveyed to the works by a culvert, so as to supersede carting of the fuel. Such an arrangement might notably contribute to perpetuate the high position which South Staffordshire has so long maintained as an iron producing district.

On the History of Petroleum or Rock Oil. By T. Sterry Hunt, *M.A., F.R.S., of the Geological Survey of Canada.*

(*Continued from page* 19.)

Supplementary Note.

We have stated in the preceding paper that the different mineral combustibles have been derived from the transformations of vegetable matters, or in some cases of animal tissues analogous to these in composition. The composition of woody fibre or cellulose, in its purest state, may be represented by $C_{24}H_{20}O_{20}$, or as a compound of the elements of water with carbon; the incrusting matter of vegetable cells, to which the name of lignine has been given, contains, however, a less proportion of oxygen, and more carbon and hydrogen than cellulose, so that the mean composition of recent woods, as deduced from numerous analyses of various kinds, may be represented by $C_{24}H_{18\cdot4}O_{16\cdot4}$. We may conceive of four different modes of transformation of woody fibre, all of which probably intervene to a greater or less degree in the production of mineral combustibles; and in considering these changes we shall for greater simplicity adopt for the composition of woody fibre the first-named formula, $C_{24}H_{20}O_{20}$.

I. When wood is exposed to the action of moist air, oxygen is absorbed, and carbonic acid and water are evolved in the proportion of one equivalent of the first for two of the last. We may suppose that for H_2 which is oxidised by O_2 from the air, the wood loses CO_2, so while the carbon increases in amount the proportions of oxygen and hydrogen are unchanged. In this way an equivalent of cellulose, by absorbing sixteen equivalents of oxygen, and losing eight of carbonic acid ($8CO_2$), and sixteen of water ($16HO$), would leave $C_{16}H_4O_4$. Such is the nature of the decay of wood when exposed to the air, and the process, could it be carried out, would leave a residue of carbon only. If, however, the wood is deeply buried and excluded from the oxygen of the air, two reactions are conceivable.

II. The whole of the oxygen of the wood may be given off in the form of carbonic acid, while the hydrogen remains with the residual carbon. The abstraction of ten equivalents of carbonic acid from one of woody fibre would leave a hydrocarbon, $C_{14}H_{20}$.

III. Instead of combining exclusively with the carbon, a part of the oxygen of the wood may be set free as water, in combination of the hydrogen. The abstraction from an equivalent of woody fibre of four equivalents of carbonic acid and twelve of water would leave a hydrocarbon, $C_{20}H_8$.

IV. These decompositions are, however, never so simple as we have supposed in II. and III., for a portion of hydrogen is at the same time evolved in combination with carbon, chiefly as marsh-gas, C_2H_4. The amount of this gas evolved from decaying plants submerged in

water, and the immense quantities of it condensed in coal-beds and other rocky strata (forming fire-damp), show the great extent to which this mode of decomposition prevails.

In nature these various modes of decomposition often go on together, or intervene at different stages in the decomposition of the same mass; they are, besides, seldom so complete as we have represented them. The first process results in the formation of vegetable mould, which always retains portions of carbon and hydrogen; while the incomplete operation of the processes II., III., and IV. give rise to peat, lignite, brown coal, bituminous coal, and pyroschists, in all of which the proportion of the oxygen is much less than the hydrogen, so that their composition may be approximately represented by mixtures of hydrocarbons with vegetable fibre. The following results have been selected from a great number of analyses by various chemists, and are for the most part taken from Bischof's "Chemical Geology" (vol. i. cap. xv.). The nitrogen, which in most cases was included with the oxygen in the analysis, has been disregarded, and the oxygen and hydrogen, for the sake of comparison, have been calculated for twenty-four equivalents of carbon:—

1.	Vegetable fibre or cellulose	$C_{24}H_{20}O_{20}$
2.	Wood, mean composition	$C_{24}H_{18\cdot4}O_{16\cdot4}$
3.	Peat (Vaux)	$C_{24}H_{14\cdot4}O_{10}$
4.	Ditto (Regnault)	$C_{24}H_{14\cdot4}O_{9\cdot6}$
5.	Brown coal (Schrötter)	$C_{24}H_{14\cdot3}O_{10\cdot6}$
6.	Ditto do. (Woskresensky)	$C_{24}H_{13}O_{7\cdot6}$
7.	Lignite (Vaux)	$C_{24}H_{11\cdot3}O_{6\cdot4}$
8.	Do., passing into mineral resin (Regnault)	$C_{24}H_{15}O_{3\cdot3}$
9.	Bituminous coal ditto	$C_{24}H_{10}O_{3\cdot3}$
10.	Ditto do. ditto	$C_{24}H_{10}O_{1\cdot7}$
11.	Ditto do. ditto	$C_{24}H_{8\cdot4}O_{1\cdot2}$
12.	Ditto do. ditto	$C_{24}H_5O_{0\cdot9}$
13.	Ditto do. (Kühnert and Gräger)	$C_{24}H_{7\cdot4}O_{1\cdot3}$
14.	Ditto do. (mean comp.) (Johnston)	$C_{24}H_9O_2$--O_4
15.	Albert coal (Wetherell)	$C_{24}H_{15\cdot9}O_{1\cdot6}$
16.	Asphalt, Auvergne	$C_{24}H_{17\cdot7}O_{2\cdot2}$
17.	Ditto, Naples	$C_{24}H_{14\cdot6}O_2$
18.	Ditto, Bastennes	$C_{24}H_{16}O_{0\cdot7}$
19.	Elastic bitumen, Derbyshire (Johnston)	$C_{24}H_{22}O_{0\cdot3}$
20.	Bitumen of Idria	$C_{24}H_8$
21.	Petroleum and naphtha	$C_{24}H_{24}$

In the above table we see the transition from peat and brown coal to lignite, and thence to bituminous coal. Professor Johnston, from his experiments on various coals, including cannel from Wigan, splint coal from Workington, and caking coal from Newcastle, deduced the composition given in 14, in which with $C_{24}H_9$ the oxygen varies from two to four equivalents. It will be seen from a comparison of the infusible Albert coal with the bitumens 16, 17, and 18, how gradual is the transition to the true petroleums and naphthas, from which oxygen is absent. The asphalts also, as will be observed, differ very much in their composition, and though generally much richer in hydrogen than the bituminous coals, the variety from Naples (17) which is completely fusible at 140° C., contains less hydrogen and more oxygen than the Albert coal analysed by Wetherell; while the idrialine or bitumen found with the mercury ores of Idria, approaches very nearly in composition to the bituminous coals 11, 12, and 13, with which many asphalts may be said to be isomeric. It is, however, probable that those oxygenised bitumens, unlike the coals, are products of the oxidation of naphtha or petroleum, by a process similar to that by which resins are derived from vegetable hydrocarbons. These formulæ must be taken as representing not the true equivalents, but only the proportions of the elements in the bodies in question, which are in most cases mixtures of various substances. This is especially true of naphtha, which may be taken as the representative of pure unoxidised petroleum, and which is separated by distillation into oils of very different boiling points. The late analyses by Uelsmann of the rectified rock oil from Sehnde, near Hanover, gave the formula $C_{18}H_{20}$, and, according to De la Rue and Müller, the greater part of the Rangoon petroleum consists of hydrocarbons in which the number of equivalents of hydrogen is a little greater than the carbon; one gave $C_{26}H_{28}$. Associated with these are, however, portions of bodies containing a less proportion of hydrogen, so that we may conceive the mean composition of petroleum to be represented, as in the preceding table, by equal equivalents of hydrogen and carbon; many forms of solid bitumen also, as ozokerite and hatchetine, have the same general composition.

By referring to what has been said above, it will be seen that the final result of the third process of decomposition of woody fibre, in which the air being excluded the oxygen is shared between the carbon and hydrogen, would be $C_{20}H_8$. A similar result would be obtained with the simultaneous evolution of marsh-gas, if we suppose $6CO_2 + 8HO + 3CH_2$ to be removed from an equivalent of woody fibre, leaving $C_{15}H_6 = C_{20}H_8 = C_{24}H_{9\cdot5}$, which approaches the composition of most bituminous coals and of idrialine. A further elimination of marsh-gas would leave a residue of pure carbon, and thus, as Bischof has suggested, vegetable matters may be converted into anthracite without the intervention of a high temperature.

The elimination of the whole of the oxygen in the form of carbonic acid would leave a compound with a large excess of hydrogen, of which it would be necessary to remove a portion in the form of water or marsh-gas, in order to reduce the residue to the composition of petroleum. We know of no combination of carbon and hydrogen in which the number of atoms of hydrogen surpasses by more than two, those of hydrogen, the general formula being $CnHn+2$, so that oils like $C_{18}H_{20}$ and $C_{26}H_{28}$ contain nearly the maximum quantity of hydrogen, and a body like $C_{14}H_{20}$, whose formation we have supposed above, could not exist, but must break up into marsh-gas and some less hydrogenous oil like petroleum.

We do not know the precise conditions which in certain strata favour the production of petroleum rather than of lignite or coal; but in the fermentation of sugar, to which we may compare the transformations of woody fibre, we find that under different conditions it may yield either alcohol and carbonic acid, or butyric and carbonic acids with hydrogen, and even in certain modified fermentations the acetic, lactic, and propionic acids, and the higher alcohols, like $C_{10}H_{12}O_2$. These analogies furnish suggestions which may lead to a satisfactory explanation of the peculiar transformation by which, in certain sedimentary strata, organic matters have been converted into bitumen.—*Canadian Naturalist.*

Sulphide of Cadmium in Fireworks.—In the following composition it is said (*Dingler's Polytech. Journ.*, Bd. clxiii. s. 397) that sulphide of cadmium gives a white flame which is surrounded by a magnificent blue margin.

Saltpetre	20 parts.
Sulphur	5 ,,
Sulphide of cadmium	4 ,,
Powdered charcoal	1 ,,

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures on Some of the Chemical Arts, with Reference to their Progress between the Two Great Exhibitions of 1851 and 1862, by Dr. Lyon Playfair, *C.B., F.R.S., Professor of Chemistry in the University of Edinburgh.*

Lecture V. (*Thursday, June 5, 1862.*)

Rags and Bones.—Showing how Waste Substances when properly applied become industrial utilities; Linen and Cotton Rags; Woollen Rags; Phosphorus and Lucifer Matches; Gelatine, &c.

The subject which I have chosen for to-day's lecture may appear somewhat repulsive, but I have selected it because it forms an admirable instance of the utilities which chemistry extracts from the most waste materials. Thinkers on civilisation have for a long time attempted to find some one material, the consumption of which might be an index of the progress of different countries in civilisation. Tea, tobacco, salt, and silk have at various times received advocates as being the proper representative measures. Liebig has differed from these views, and has proposed as the true measure of the progress of a nation, the amount of soap which it consumes, because the more cleanly and civilised a nation is, the larger is the amount of soap which is used in it, and the greater is supposed to be its progress. The difficulty of admitting this index depends upon the chemical fact that the quantity of soap consumed by any people depends very much upon the geological character of the district in which they are situated—as this determines whether the water is hard or soft. The people of Manchester and Glasgow, rejoicing in a soft water, use much less soap than we do in the Metropolis, where the water of the Thames is our only resource; and yet we in the Metropolis could not claim a higher degree of civilisation, because we consume nearly double the amount of soap used by the inhabitants of Manchester and Glasgow. If in such a complex thing as civilisation, it were possible to take any one substance as a true index of the state of prosperity and enlightenment of a nation, I would certainly put in a claim on behalf of the subject of to-day's lecture, and use the price of rags as the standard of its progress, because the demand for rags is merely in another sense a demand for enlightenment and mental cultivation. It is the duty of an enlightened people to gather rags from barbarous nations who do not appreciate their value, and convert them into that paper which is the source through which we obtain our information and intellectual enjoyment; so that it is quite true that as nations rise high in the world they appreciate the value of rags more, and are willing to give more for them in the market.

I think, therefore, that I have chosen a subject which is well worthy of your attention, and I desire to follow out, as much as I can do with the extensive number of subjects which present themselves for our attention, the value of rags and the applications which have been made of them in recent times. As, however, I am confined in my illustrations to the last decade, and have to describe what has been done since 1851, and not to go generally over the subject, I must direct your special attention to one application which has arisen during that time; but before doing so, I would remind you that the rag trade is one which has now become very extensive. There are no less than 15,000 tons of cotton and linen rags annually imported into this country; and as that is only one-fifth of the entire consumption, four-fifths of the rags used being derived from the waste of our population, there are about 75,000 tons of rags annually converted into paper in this country, representing a money value of the raw material equal to 700,000*l.*; and as one ton and one-third of a ton of rags make one ton of paper, you can readily conceive that the economical application of rags is of very great importance.

Now, the chief discovery in the last decade, with regard to the application of woollen and linen rags, is the formation of that paper which you see there, and which has received the name of "parchment-paper." It is made by a very simple process. Ordinary water-leaf paper, as it is called, that is, common white blotting-paper—for you know it better by that name—is simply dipped into diluted sulphuric acid; but the dilution must be exact. If you err on either side, even within very small limits of error, you get a waste product and not parchment-paper. If your acid be too weak, you convert the paper into a gum; and if the acid be too strong you corrode the paper, and do not get what you desire. In order to produce this beautiful parchment-paper, you must take exactly two measures of strong oil of vitriol—sulphuric acid—and one measure of water, and mix them together. They first become heated, and you allow them to cool; and after they have cooled to the ordinary temperature they are ready for use. Nothing is more simple. I take a bit of water-leaf paper and dip it into the mixture. I simply allow it to pass through, and my parchment-paper is made. The best paper for this purpose is that which has been well pulped, or well disintegrated in the making. The conversion of it into parchment-paper is an exceedingly simple operation. I now place it in ammonia, which takes away the acid, and there is the parchment-paper completed, so that you see nothing is more easy. What have I done? Although I have effected such a transformation in the paper that it is now much stronger than it was before, we have added actually nothing to it. The acid has not entered into its composition. I have taken nothing away from the paper. It is the same weight after it has dried as it was before. It is simply a molecular change which has occurred in the character of the paper, the pores of the water-leaf having become closed, and it is now repellant of water. Here are some examples of this paper; and you will see how properly it has been termed "vegetable parchment," because it has all the properties of the ordinary animal parchment, which, you know, is made from the skins of the sheep and of the she-goat. It is a semi-transparent body with great elasticity. You can bend it backwards and forwards without cracking, and the strength of it is much increased. You see that although this was only a piece of common blotting-paper converted into this material, I have great difficulty in tearing it; therefore, the strength which the paper has acquired is considerable. It is repellant of water, but it allows some fluids to pass by a process of diffusion; and when it is stretched upon a sort of drum, or a sieve frame, or wooden circle, it forms an instrument, which, in the hands of the Master of the Mint, has produced that elegant process of separation, or diffusive analysis, which he has called "Dialysis." The strength of the paper is so much increased by this operation of simply subjecting it to the action of the acid, that a strip of paper which requires sixteen pounds weight to break it when it is in the state of the water-leaf, requires seventy-five pounds to break it after it is passed into the other state. There is a little experiment which I will try, only I have no fire here to do it completely, to show you how narrow are the limits of the mixture of acid which you must attend to. Suppose I place a drop of water upon one part of the paper,—I will place three drops on it,—and dip the paper into the mixture of acid, the water on the paper dilutes the acid in those particular places, and is quite sufficient to prevent the formation of the parchment at that place. You see that I get the formation of the parchment everywhere else; but look at the holes where the water was. Where I put the drops of water, the paper has gone into holes, because the extra dilution was quite sufficient to prevent the acid acting properly.

Now, this property of sulphuric acid with regard to

paper was discovered in 1854 by Mr. Gaine; but it was not until some years afterwards that Mr. De la Rue, by extensive experiments, was enabled to form parchment-paper as a commercial article, and it is now used for a great many purposes. There are some deeds written upon it. It is now extensively employed by ladies for covering preserve-pots, and is used for a great many other useful purposes.

As there is nothing decidedly new in the manufacture of ordinary paper during the last decade, I now pass to the consideration of woollen rags.

Woollen rags have become extensively useful of late years. They cannot be converted into paper, but they can be converted into a great many substances; and, perhaps, some of my lady hearers will not quite thank me for the information which I am going to give. It is interesting, nevertheless. After garments have been worn and have gone through their common use and wear, they are by no means useless. They possess still a high money value; and these woollen garments, these clippings of the tailor, old rags, and old worn coats, when we have done with them, are all cut up, and torn to pieces. They have a little oil placed upon them, and are blown through a blower to get them into a fine state of division; and then they are sold as wool under the name of "mungo," or of "shoddy." Now, this is sold at about one-third the price of ordinary wool. The wool obtained in this way by breaking up these old rags is sold at from sixpence to a shilling a pound, and it forms excellent cloths. For instance, those light ladies' cloths which they wear as mantles are almost all made from these old rags. This cloth here, for instance, is made from these old rags. It is also used extensively for mixing with wool, because it gives a greater lustre and a certain fineness to the cloth; and therefore it is often used for mixing in ordinary woollen cloths. The coarser varieties are used for druggets and other purposes; but it is all used up. There is a portion of it which becomes waste, which will not make good wool. This, for instance, is the mungo waste, as it is called, which cannot be worked up into a cloth; but it is only waste as regards cloth-making. This waste is powdered and dyed with brilliant colours, and is then made use of for making flock-paper, such as we have in our ordinary apartments. For that purpose the paper is printed in a pattern with gum or with size. This powdered waste wool which has been dyed and prepared is then sieved over the paper, and it sticks where the gum or size has been printed on. In that way it forms the ordinary flock-paper.

You see that the ordinary woollen rags possess great value, and when you see such cloths as this produced from the shoddy or mungo which is got from the old woollen rags, we cannot regret that such a profitable kind of manufacture has arisen.

But there was one kind of semi-woollen rags that for a long time defied the economist in making use of them. These were the muslin-de-laines. As long ago as 1834, in the cotton districts they learnt how to put a cotton weft with a woollen warp. The cloths thus produced were finer in texture and cheaper than the woollen cloth, and therefore there was a great demand for them. It was, however, scarcely worth while to take these muslin-de-laines as rags after they were worn out and economise them. The reason of that was, that you had two fibres of different kinds, one of wool and one of cotton, and you had to sacrifice one in order to get the other. For instance; if you desired to get the wool, you steeped the muslin-de-laines in acids, and converted the cellulose or woody fibre of which the cotton consisted into sugar, and the cotton being converted into sugar was lost, but the wool was obtained and used. If, on the other hand, you wanted to save the cotton of this mixed fabric, you dipped the material into an alkali and dissolved the wool. The alkali did not dissolve the cotton, but the wool, being dissolved, was separated from the cotton, and the cotton was saved. Now, Mr. F. O. Ward has shown in the Exhibition a pretty process for economising both fibres, or at least for getting a chemical product from both fibres, and it is very simple. Here are the rags as they are presented—the rags containing both of the substances—cotton and wool. They are subjected to a current of steam at three or four atmospheres,—that is to say, hotter than ordinary; and when this heated steam passes through the rags it converts the wool into a sort of bituminous or resinous matter which becomes brittle. There is a portion which has been acted on by the steam. I agitate it, and the wool separates as a powder, and the cotton is as firm and as strong as it was before. All the wool has gone away from it, because it has been converted into this resinous substance. When this wool becomes dry, it can be separated by a kind of combined beating and sieving process; and now there remains the cotton. The cotton in this state is sold as ordinary cotton rags to the bleacher who bleaches it, and is converted into paper. There is some paper made from the cotton rags bleached in this way. This substance which I have shaken off here, and which has come upon this paper, is the wool, and is still valuable. It contains 12 per cent. of nitrogen, and therefore is in a condition which makes it a good manure, and it is sold as such under the name of "ulmate of ammonia." I ought to tell you that the woollen rags are never too waste to be converted into manure. All the early broccoli which comes up from Cornwall is forced on by being manured with these woollen rags.

In order to get over my subject of waste products to-day I must go to another material,—the prussiate of potash. It is true that I have no claim to say that within the last ten years there has been any discovery in respect to this substance. Attempts have been made to improve the manufacture largely, but without any great success. Still, it is such an interesting application of the waste substances which contain nitrogen, that it would not do to pass it over in a lecture upon waste materials. In the making of prussiate of potash, almost all the things which are too waste and too refuse to be employed for the higher purposes of waste substances, such as I have shown you there, as cloths and paper-hangings, are employed for making this salt. For instance, the horns of cattle, the hoofs of cattle, clippings of leather, the cast-off woollen garments of the Irish peasantry, and all sorts of things which are refuse, are mixed up with pearlash, or carbonate of potash, which, you know, comes from the ashes which remain after the combustion of wood, and with old scraps of iron. Old iron hoops from beer-barrels, broken hoops, iron nails, old iron horse-shoes, or any old scrap iron which can be obtained, is mixed up with this refuse, pearlash, blood, and other substances, and they are all fused together in a pot, and after they are fused in this way they are dissolved out in water, and then they are transformed from their ugly primary condition to this beautiful salt, which is yellow prussiate of potash. It is a cyanide of iron and a cyanide of potassium. The nitrogen combines with the carbon and forms cyanogen; and then the cyanogen combines with the iron and the potassium, and forms this prussiate of potash. This salt is very extensively employed, because it is the source of Prussian blue. I have here a solution of iron rust which I add to this solution of the yellow salt. You see immediately that a copious precipitate of Prussian blue is produced—that beautiful colour which we employ so extensively. Now, if you pass chlorine through yellow prussiate of potash you remove one equivalent of potassium, and then you get this other salt, the red prussiate of potash, which, though it differs from the other merely in containing one equivalent of potassium less, yet is changed in its chemical characters considerably. The yellow salt is not poisonous, but the red

salt is intensely poisonous. This also with another salt of iron—a proto-salt of iron—forms Prussian blue. If I put some of this red salt into the water, and add a lower oxide of iron, it forms a Prussian blue of a characteristic brilliancy, which enables it to be used in many cases in preference to that produced from the other salt. I need not show you any experiments in dyeing with these beautiful salts, although I have them here, for I showed them to you in the former lecture. You see, therefore, that this Prussian blue is a product made from extremely waste materials—substances too waste to be used for such purposes as I first described to you.

Within the last couple of years there has been a little discovery which may become a greater one than it appears just now, and that is, the manufacture of a particular gunpowder,—which is called "white gunpowder,"—from this substance. If I take 28 parts of that yellow prussiate, 23 parts of cane-sugar, and 49 parts of chlorate of potash, and then sieve them so as to mix them together, we get a description of gunpowder, as you see by its action [exploding some]. This gunpowder has certain advantages even above ordinary gunpowder. Weight for weight, it forms nearly double the volume of gas that common gunpowder yields; and it leaves less residue behind. Although you may think that considerable [referring to the ash left by the white gunpowder which had just been fired], it is still less in quantity than the amount which is left by ordinary gunpowder. But the temperature of the flame on ignition is not so high; so that, although the white gunpowder produces double the amount of gas, that gas is not heated so much, and therefore does not expand so much as in the case of ordinary gunpowder, and the projectile force of this white gunpowder has not answered the expectations formed of it. Still it is so exceedingly easily made—by simply taking these materials, prussiate of potash, chlorate of potash, and sugar, sieving them separately so as to get them fine, and then sieving them in their proportions together so as to get them mixed, that it may have some advantages. There is required none of the mechanical applications necessary in the manufacture of ordinary gunpowder, such as the milling and glazing and granulation, which make its manufacture so troublesome and expensive.

I now pass to the other subject which I have mentioned in my lecture to-day—Bones.

Rags and bones are naturally associated in one's mind. The same collector collects both; although I confess that I am somewhat sorry for their association to-day, because the chemistry of bones is so extensive that I scarcely know how to handle it in half a lecture. I must therefore pass over their known applications—the applications which are so familiar to you. I can say nothing of their use as a manure, either in their ground or subdivided state, or as they are often used, after being treated with sulphuric acid, under the name of superphosphate of lime. I cannot even, interesting as it is, dwell upon the fact that within the last few years we have learnt actually to take up and apply the bones of extinct animals—of the old reptiles which during the Saurian period spread terror through the seas and estuaries of the time. The bones and exuviæ of these animals are now used as manure. They are ground and mixed with sulphuric acid, and sold under the name of "superphosphate of lime."

In this country the importation of bones for mechanical and chemical purposes, amounts to from 70,000 to 80,000 tons per annum. The mechanical purposes for which bones are used are such as the making of handles for knives. The quantity imported represents a money value of 400,000*l*.

When we examine the chemical composition of bone, we find it to consist of an organic matter 33 parts, of phosphate of lime 57 parts, of carbonate of lime 8 parts, and of fluoride of calcium and phosphate of magnesia 2 parts, making 100 parts. Now, I can easily show you the earthy matter, taking it generally, and the organic matter. I have here put a bone, which was of the form you see it here, in a little weak muriatic acid. That has dissolved out the earthy portion and left the organic matter on the cartilage as you observe, which you see is quite soft. It has all the shape of a bone, but the inorganic matter which gave it its solidity is gone, and you see it is quite soft. Now, this cartilage is extensively used for purposes which I have not time to enter into, because that is not what I have to deal with. It is used extensively in making a glue or size used for stiffening calico prints, which is of a less stiff and firm character than the glue used for ordinary purposes. The bones are boiled, and this cartilage becomes converted into gelatine, or into the jelly with which you are familiar under the name of "calves'-foot jelly," in which the cartilage is changed into a gelatinous substance. This is extensively used, and it is a subject which one would like to dwell upon, but I cannot.

If instead of taking out this gelatine by boiling it, you take the bones and calcine them with this cartilage in them, the bones are converted into a black substance which is called "bone-black." The fact is, the cartilage becomes carbonised, the volatile matters are driven off, and the earthy matters of the bone become mixed with charcoal, which remains behind. This charcoal is extensively used for the purpose of decolorisation. It is that which is employed for the purpose of making brown sugar white. If any coloured organic substance be passed through these calcined bones, and you allow it to go gradually, you will find that it filters through with the colour, perhaps, not wholly removed by the first operation, but it will be removed by the second. You see this liquid is now passing through almost wholly decolorised, because this charcoal has a strong affinity for the colouring matter and unites with it. This bone-black is extensively used for decolorising syrups and other things.

When this bone-black is formed by the calcination of the bones, there is also a large quantity of oils which distil over, and which are sold under the name of "Dippel's animal oil," useful for various purposes. But it is chiefly in relation to the phosphorus in the bones that I wish to direct your attention. The earthy matter of bones consists of three equivalents of lime united with one equivalent of phosphoric acid. It is what chemists term "a tribasic phosphate of lime." Phosphoric acid, as you are no doubt aware, consists of one equivalent of phosphorus united with five equivalents of oxygen. In order to obtain the phosphorus, it is only necessary to take away those five equivalents of oxygen, which we can do by mixing the compound with charcoal after some preliminary operations, and heating them together. The charcoal takes away the oxygen and forms carbonic oxide with it, whilst the phosphorus distils over. In this way we get phosphorus in the condition in which you are very familiar with it. Here it is in the state in which we obtain it, by this distillation, after it has been again melted and filtered through chamois leather, and cast into quill tubes. You see it is a wax-like substance, which I must handle with care, because if I allow it to dry, the heat of my fingers would be sufficient to inflame it. Now, observe what this substance looks like. It is semi-transparent; it is soft; you can cut it like wax. It is exceedingly poisonous, and in the making of lucifer-matches it is found to be a very insidious poison. Lucifer-match makers are apt at first to be subject to an affection which does not draw much attention. They complain frequently of toothache, but they do not know the insidious disease which is creeping upon them. I will not pain you by describing this disease in its progress, but will merely say that the lucifer-match makers who make lucifer-matches from this phosphorus are subject to the most distressing of all diseases; the jawbone becomes destroyed, and frequently disappears or becomes useless,

and some of them spend the greater part of their lives in the wards of hospitals.

It therefore became an important point for science to find some way by which this phosphorus should be deprived of its poisonous properties without losing those chemical characters which make it so useful in making matches for instantaneous light. Now, a gentleman who is at present in London, as one of the jurors of the Great Exhibition, met this want of science in a very skilful way. Bodies are capable of assuming two conditions, and sometimes more, which the chemist calls "allotropic" conditions; that is to say, they are, in fact, old friends with new faces given to them by some artifice, but still being the same body and not having gained or lost anything. Now, here is our old friend phosphorus with certainly a new face. By taking common phosphorus and exposing it for some time to a temperature of 470°, this yellow waxy transparent substance transforms into a dark brick-like substance. It is no longer so inflammable as to ignite spontaneously. I place it in water because it will ignite upon the application of a light, and it is best to keep it away from the possibility of those conditions under which it might be accidentally ignited. It may be packed up in boxes without danger of spontaneous combustion; but what is more important, it has lost all its poisonous properties. The phosphorus, which was poisonous before, is no longer poisonous in this allotropic condition, and it is still capable of being used for making lucifer-matches. In passing into that allotropic state it has lost its power of dissolving in bisulphide of carbon, and if any of the old phosphorus remains in it, it may be dissolved out by this bisulphide of carbon. I have here some of this ordinary substance which is dissolved in bisulphide of carbon, and if I pour it now over this paper you will see the properties which it possesses in a very short time. It will ignite of itself as soon as it becomes sufficiently dry by the passing off of the bisulphide of carbon. When this evaporation takes place the phosphorus is left in such a fine state of division upon the paper that it bursts into flame. The allotropic phosphorus is altered very considerably in its chemical characters.

In consequence of the great use of phosphorus now in this country in making lucifer-matches, you will, perhaps, allow me to go much beyond our decade at present, and describe to you a little in detail the history of the manufacture of lucifer-matches, because it forms one of the most interesting points in the history of the arts which we possess.

I cannot tell you who was the first inventor of a means of getting instantaneous light. Many admirers of Prometheus declare that it was Prometheus, but he does not do so himself. He says this:—

> "I am he who sought the source of fire,
> Enclosing it hid in my narthex staff;
> And it hath shown itself a friend to man,
> And teacher of all arts."

You recollect the circumstances under which Prometheus got the fire. Jupiter was so angry with Prometheus for having stuffed a bull's skin with bones and passed it off as a real carcase for a votive offering, that he took away fire from the earth to punish Prometheus. We might suppose that the father of the gods removed the fire lest the ingenious Prometheus should have made phosphorus from the bones, and thus become independent of the gods. Whether man would thus have been independent of the gods for fire I do not know, but fire was taken from the earth. What Prometheus actually did was only to steal fire from the chariot of the sun and keep it alive, until he reached the earth and gave it to man, by blowing it with the pith of the giant Fennel, which he used as a staff. We are told by Pliny and Virgil that the tinder-box, similar to those used by us, was well-known in their time. They describe the properties of the flint and steel, and Virgil says that dry leaves may be ignited by means of the flint and the steel with the rapidity of speech. The savages of various countries found for themselves a means of getting a light, which was far from instantaneous. I think that it would require much more dexterity than we can employ, to demonstrate how a light may be got by rubbing together two pieces of wood; but we can get sufficient heat in that way to ignite some substances which are more combustible than the wood itself. Mr. McIvor will rub these two pieces of wood together, and you see that in a little time they become very hot. Now they are smoking violently. Observe that there is now heat enough to ignite a piece of phosphorus readily. In this case the friction by a philosophical process, which I need not describe just now, is sufficient to produce a large quantity of heat; and savage tribes have been accustomed to use that friction to obtain a source of light. For a long time, as many of my older hearers will recollect, our only means of obtaining an instantaneous light, even within my own recollection, was the tinder-box. The tinder-box with its trio was familiar to many of us—burnt-rag, flint, and steel. These were used to obtain a flame, and then in addition to this trio there was the sulphur-match, which was ignited after the flame had been obtained by the sparks falling among the burnt-rag. If the rag were not damp, and everything was in perfect order, you could get a light in a short time; but if the rag were at all damp, or the day was draughty, you might get a light perhaps in a quarter of an hour. [The lecturer here illustrated the use of the tinder-box]. There, now we have got a light, and by blowing it up I may succeed in getting the sulphur-match alight. I recollect when I was a boy remaining for at least half an hour in a castle which I was to be shown over, whilst a light was got in this way. Tedious, however, as this process is, I find that there are even in London at this very moment some venerable ancients who still use nothing but the tinder-box as a means of obtaining a light. I bought this specimen in the Edgware Road, and I was assured by the shop-keeper that there was still a steady though not brisk sale for this antiquated contrivance, and that notwithstanding lucifer-matches there are several who resort to this mode of obtaining a light.

The first invention which led the attention of chemists to the importance of a means of obtaining an instantaneous light occurred in 1820, when Doberemer produced a lamp of an elegant character. You will see it represented in this diagram. Here is a vessel in which hydrogen gas is collected. The hydrogen gas is formed by the action of sulphuric acid and water upon zinc. These acting upon the zinc produce hydrogen, and the hydrogen rises here, and as it is formed it expels the acid from the vessel, so that it no longer acts upon the zinc. I have in this way a reservoir of hydrogen; and now if I take a piece of spongy platinum, which has the power of absorbing oxygen from the air and condensing it within its pores, and bring this platinum in contact with the hydrogen, you see that it gets red hot, and ignites the hydrogen. Thus, you see that this plan of applying hydrogen for the purpose of acting upon the oxygen condensed in spongy platinum is a method by which a light can be obtained. The spongy platinum absorbing oxygen, presented oxygen to the hydrogen, and caused the formation of water, and in the formation of water so much heat was produced that the hydrogen became ignited, and a light was obtained. One disadvantage which prevented it being universally adopted was simply this: that the least speck or fouling of the spongy platinum puts the lamp out of order. For instance, this may have been in order five minutes ago, and it may be out of order now. Some dust or dirt may have got upon the spongy platinum. Still, the application was so elegant that it drew the attention of scientific men to the importance of getting an instantaneous light.

The next invention consisted in mixing phosphorus and sulphur in a bottle, and then taking them out upon a

splint of wood, which was rubbed, and a light obtained in that way.

Then came the method of getting a light by means of chlorate of potash and sulphuric acid. Here I have some chlorate of potash mixed with sugar, and I place a little of it on a plate. I will not put too much because of the fumes. I now dip this rod in sulphuric acid so as to get a little on the end of it, and with this I touch the mixture of chlorate of potash and sugar. The sulphuric acid liberates the chloric acid, which gives oxygen to the sugar; the sugar burns, and an instantaneous light is obtained in this way. Captain Manby used this process for firing off his safety mortars, and thus drew considerable attention to this mode of obtaining a light. An application of this chlorate of potash and sulphuric acid to match making was now made. There were two applications: one was older than the other. The method which was first introduced consisted of having a little bottle of asbestos. Here is one of the old kind, which many of us recollect. This asbestos is moistened with oil of vitriol, and the chlorate of potash and sugar, instead of being separate, as I showed you there, are put upon the end of the match, and you dip it in the sulphuric acid, and the chlorate of potash and sugar mixture gets ignited, and the light is got in that way. Well, that was the first application of the old experiment of chlorate of potash and sugar. Then there was another. I am sorry to say that I have only one or two of these ancient matches left, and they will soon be gone altogether. The plan was to take the chlorate of potash and sugar, and wrap it up in a piece of paper, and to have the sulphuric acid sealed up in a little glass globule inside the mixture. The mode of using it was, if you had a pair of pincers at hand, to break the globule with them, and so ignite the match; but if you had not a pair of pincers in readiness, you did it between your teeth; and if you were very clever, you might do it without getting the sulphuric acid into your mouth, or burning it with the explosion. This match had a great objection—that chlorate of potash and sugar always go off violently, and the sulphuric acid in the globule, although in small quantity, was spirted over the dress, and destroyed the dress whenever it came in contact with it.

The first friction-match was introduced in 1832. The mode in which these friction-matches were made, many of my hearers who lived in 1832 will recollect. I have a lively recollection of it. The mode was this—sulphide of antimony was mixed with chlorate of potash. Here the sulphide of antimony gave sulphur, just as the sugar gave a combustible to the chlorate of potash. This was put upon the end of a piece of wood; and the friction was produced by drawing this through a piece of sand-paper. I have there some antique matches of all kinds, which are now very valuable because they are very difficult to obtain. My experience as a boy with regard to these friction-matches was that with considerable adroitness you might get a light after pulling off the ends of half a box; and then when it did come, it came with such violence and explosion that it projected a considerable quantity of the ignited matter over the hands and burnt them. You might get a light for 6d. or 8d.; at least, that was my experience as a boy. My seniors may have been more successful.

In 1834 the phosphorus-match was invented. In this, after a time, sulphur became substituted for sulphide of antimony, and it was a great improvement upon the old congreve. At first the phosphorus-match was violent in its action, and it projected its melted materials over the fingers unless you held it carefully, and the reason of that was that nothing but chlorate of potash was used as the oxidiser. The friction produced the heat necessary to ignite the phosphorus; the chlorate of potash gave it the oxygen, and it burnt violently. After a time manufacturers learnt that it was better not to take chlorate of potash by itself, but to mix it with some less energetic oxidising agent,—as, for instance, with saltpetre or nitrate of potash, or with peroxide of lead, or with some agent less energetic than the chlorate of potash. In this way the phosphorus-match became much improved in character. The sulphur which was used to carry out combustion, and to get up sufficient heat to make the wood ignite, was also gradually substituted in the better kind of matches by melted stearine. The wooden match was dipped into melted stearine, and all possibility of fumes of sulphur was in this way obviated. The common phosphorus-match became gradually improved, and its use has now increased to such an extent, that it may surprise you to know that there are some chemical works in this country where they make nine million of matches daily. In France and England alone 300,000 pounds of phosphorus are annually made into matches, and as three pounds of phosphorus are sufficient to tip five or six million of matches, you can conceive what a large industry this has become. But the larger the industry has become the greater has been the evil with regard to the workers. On account of the extreme cheapness of the phosphorus-matches there is a desire to make them of the cheapest materials, and as this waxy phosphorus is cheaper than this allotropic phosphorus, all the common matches are, of course, made with the ordinary phosphorus. I show you a better kind of matches, which I hope all my hearers will encourage, which are not made with the waxy phosphorus, but with the allotropic, or brown phosphorus. You may easily know them by their brown ends. The allotropic phosphorus fortunately answers equally well for the purpose, and is not at all poisonous to the match makers who have to use it. There are two kinds of matches made with the allotropic phosphorus. One kind is made like the ordinary match, with the oxidising material, and the allotropic phosphorus mixed together and put upon the end of the match. It, therefore, differs from the ordinary kind only in the fact of its being made with allotropic phosphorus. But there is another kind of match which has been manufactured, and it is an exceedingly beautiful invention. Here the oxidising material alone is put upon the match, the phosphorus not being put upon the wood. It is not, therefore, a match of the ordinary kind. You could not get it to ignite in the usual way. Here the oxidising material is put upon the piece of wood, and the allotropic phosphorus is put upon the friction-paper mixed with the emery. This piece of wood does not, therefore, become a match until I take off a certain quantity of that phosphorus along with my oxidising material, by rubbing it upon the paper upon which the emery and phosphorus are spread. The value of that device is great, because there can be no accidental firing, as in the ordinary matches. Trampling upon them, or leaving them too near the fire, cannot make them ignite, because the match is not a match until it is drawn over the sand-paper and takes up phosphorus. Accidental ignition is thus prevented.

I now see that my hour is exhausted, although my subject is not; and I can only conclude by stating generally that although you may consider the rather multifarious waste materials which we have brought together and viewed in their general application to industry as at first sight apparently repulsive, they lose entirely their repulsiveness when you see them converted into these elegant utilities. Even those rags which are made into these beautiful cloths, or the cotton rags which are made into paper, have all undergone such a complete purification, and such thorough changes in their progress to utility, that they may be worn or used with perfect safety, and they produce utilities which are even elegant in their character. Therefore I trust that I have shown you that chemistry in its economy produces objects of great value from the most waste materials. I am going to ask you in my next lecture to follow me in what Nature does in the same way, and to show you that Nature allows nothing to be wasted, and that all those substances which we regard as waste and repulsive become

useful materials under the transforming influence of natural causes, and that thus nothing is lost in the economy of the universe.

CORRESPONDENCE.

New Facts regarding Strychnia and the Nitro-prusside of Sodium.

To the Editor of the Chemical News.

Sir,—I beg to contribute further information on this point as fresh facts develope themselves in proof of the value of this reagent which place the matter beyond dispute, and I have much pleasure in inviting the attention of my brother chemists to them.

If in precipitating strychnia solutions by nitro-prusside of sodium, as suggested in my previous papers, a whitish or yellowish white precipitate be obtained, a little of it be taken up into a pipette, as free from adhering liquor as possible, transferred to a small porcelain capsule and touched with sulphuric acid, the characteristic colour is instantly developed. Such, however, is not the case when the precipitate after being separated by filtration is washed with water and used moist before being oxidised by the air, as then no change of colour is induced, the compound being simply dissolved by sulphuric acid, forming a more or less colourless liquid. If now you take say the $\frac{1}{100}$th of a grain, on the point of a pen-knife, of peroxide of manganese, lodge it at the top of a capsule, and gently incline it so as to bring the liquid in contact with the manganese, the most beautiful and intense play of colour is brought out, which is more persistent than usual.

In this experiment we have the most conclusive evidence of its intrinsic worth, as there cannot be any possible mistake or collusion with any other alkaloid or chemical reagent, nor even with any organic vegetable or animal matters, as those remain in the filtrate.

To suppose this effect is due to nascent oxygen liberated from so infinitesimal a portion of manganese, is, in my opinion, a fallacy, for I rather consider it due to some kind of exciting catalytic force being set up; but, whatever be the cause, there is no longer any doubt about the efficacy of this test, which has from some unexplained reason or other been slighted upon insufficient grounds.

I am, &c. John Horsley, F.C.S.

The Laboratory, Cheltenham.

Mr. Horsley's Test (?) for Strychnine.

To the Editor of the Chemical News.

Sir,—Mr. Horsley would, I think, have acted with more discretion had he, prior to penning his philippic published in the last number of your valuable Journal, just considered that it was possible—barely possible—that I, after having for many years devoted myself to toxicological research, and having for the last eighteen years had an extensive practice in toxicological analysis, could apply a test; and had, consequently, purchased other and fresh materials to verify his first results. I have never for a moment doubted that Mr. Horsley obtained the effects he records from the agents he employed, but what I said, and still most emphatically do say, is, that pure strychnine, sulphuric acid, and nitro-prusside of sodium did not, and will not, produce the coloured effects he asserts, nor could it be expected by any one conversant with the properties of the nitro-prusside.

Although the nitro-prusside of sodium does not act as a colour-test, its addition does not prevent the action of the ordinary colour-tests upon strychnine. With this knowledge I have experimented with no less than five different samples of the nitro-prusside prepared by as many different makers,—all producing the same negative results. I have done so simply to ascertain if any specimen could possibly be found containing the necessary oxidising agent as an impurity. This is a serious question, and Mr. Horsley has incurred a grave responsibility by the publication of crude results. I wish to deal most temperately with the subject, but as Mr. Horsley has written that he is "not given to put forward impracticable projects," I must, in conclusion, ask that gentleman whether he has not done so when he talks of dissolving 1 grain of strychnine in 100 grains of water?—I am, &c.

J. E. D. Rodgers,
Formerly Lecturer on Chemistry at the St. George's School of Medicine.

41, Denbigh Street, Pimlico, July 15.

On the Detection of Strychnia in the Presence of Morphia.

To the Editor of the Chemical News.

Sir,—Alarmed by the statements with respect to the difficulty of detecting strychnia in the presence of a large proportion of morphia, I have just made the following experiment, which may prove interesting to some of your readers:—

A hydrochloric solution containing 0·5 grain of morphia and 0·01 grain of strychnia in 100 measured grains, was rendered alkaline by potash, and shaken with about three times its volume of ether. The decanted ethereal solution, when evaporated, left a residue weighing 0·03 grain. On moistening this with concentrated sulphuric acid it effervesced very slightly and became brown, but on immersing the end of a glass rod dipped in solution of chromate of potash, a very distinct strychnia reaction was perceived, and could be manifested at pleasure by drawing the stirrer over any part of the watch-glass.

It is easy, therefore, to detect $\frac{1}{100}$th of a grain of strychnia in the presence of fifty times its weight of morphia by following one of the simplest processes generally adopted in examining organic mixtures. The use of ether is sometimes to be preferred to that of benzol (lately recommended by Mr. Rodgers), since the latter solvent cannot always be so readily obtained in a state of sufficient purity on the spot.—I am, &c. C. L. B.

Separation of Silver from Copper.—Berlandt publishes (*Archiv. für Pharm.*, Bd. clv. s. 279) a process for separating pure silver from an alloy of silver and copper. He dissolves the mixed metals in nitric acid, and evaporates the solution to dryness to get rid of excess of acid. He then dissolves an ounce of the salts in five ounces of water, filters the solution, adds fourteen ounces of a solution of protosulphate of iron (five and a-half parts sulphate to eight and a-half parts water), mixes and stirs well. The greyish-white deposit, washed with very dilute sulphuric acid, and afterwards with water, is found to be pure silver.

ANSWERS TO CORRESPONDENTS.

Phar. Student.—The crystals turned out to be chloride of potassium, and not an organic alkaloid or salt. Such crystallisations of alkaline salts from extracts are not uncommon.

J. G. B.—We shall probably give detailed information on the subject in a subsequent Number.

B. Y. C.—Good rectified benzol is as good a material as you can use for cleaning gloves, silk, &c. The more volatile portions of paraffin oil have also been used successfully for this purpose.

A Chemist.—If you forward name and address to the Editor, a private communication will be sent.

Potassæ Picras.—John M.—This is the same as carbazotate of potash. It is precipitated in slender needle-shaped crystals upon adding an alcoholic solution of carbazotic acid to a soluble potash salt. It may be readily purified by recrystallisation. Braconnot has used it with good success as a substitute for quinine in intermittent fevers. Dose from two to five grains.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Action of Substances of the Sulphur and Phosphorus Groups on Solutions of the Metals, by THEODORE PARKMAN. (*Abridged from his Inaugural Dissertation, Göttingen.*)

THE subject of the following dissertation was suggested by an observation made in the laboratory of Professor Wöhler, at Göttingen. In precipitating selenium, by sulphurous acid, from a solution which contained considerable copper, the selenium obtained was black, although the precipitation took place in the cold. On investigation, the selenium was found to contain copper. My honoured instructor, Professor Wöhler, suggested to me that, as this reaction was a new and somewhat singular one, to extend it to tellurium, sulphur, phosphorus, arsenic and antimony, might afford the matter for a not uninteresting investigation :—

I. *Action of Sulphur on the Solutions of Copper, Silver, and Lead.*

As just mentioned, precipitated selenium, placed in a solution of sulphate of copper containing sulphurous acid, unites with copper. I find that sulphur, tellurium, phosphorus, arsenic, and antimony, all do the same. In most cases, also, the same effect is produced, especially with the aid of heat, without the presence of sulphurous acid, or other reducing agent. I have also extended the investigation, though less completely, to the salts of silver and lead. With the exception of the action of phosphorus on the copper and silver solutions, all these reactions appear to have been previously undescribed.

1. Action of Sulphur without the aid of Reducing Agents.—Precipitated sulphur and flowers of sulphur were left a week in solutions of sulphate, acetate, and chloride of copper. At the end of that time they were entirely unchanged. Precipitated sulphur, boiled five or six hours with the sulphate, was slightly blackened, from formation of sulphide. Precipitated sulphur and flowers of sulphur, boiled with the acetate, rapidly blackened, and were finally, apparently, entirely converted into sulphide of copper. Sulphur* left three days in solution of nitrate of silver, became dark grey; boiled in solution of nitrate of silver, it became rapidly black, and seemed to be entirely converted into sulphide of silver. Sulphur, boiled with acetate of lead, only by very long boiling became dark grey.

2. Action of Sulphur with the aid of Reducing Agents.—Sulphur left for some hours in solutions of sulphate, acetate, and chloride of copper, with which sulphurous acid was mixed, became gradually dark grey, from formation of sulphide. Left a week in similar solutions, it appeared to be almost entirely converted into dark blue or black sulphide of copper. By boiling the solutions, the reaction took place much more rapidly, the sulphur becoming black in a few minutes. Sulphur, green vitriol, and sulphate of copper, boiled together, gave sulphide of copper rapidly. Sulphur, zinc, and sulphate of copper, boiled together, gave, along with reduced copper, black sulphide.

Sulphur boiled with acetate of lead and acetate of the protoxide of iron, became rapidly black, and was apparently completely converted into sulphide. The resulting sulphide contained no iron.

3. Analysis of the Products of the Foregoing Reactions.—In preparing the above substances for analysis, my great care was to continue the action long enough to be sure that all the sulphur was converted into sulphide. In those prepared by simply boiling the sulphur with the solution of the metal, the boiling was continued from five to eight hours, in every case with an excess of the metallic salt. In preparing the sulphides by the aid of sulphurous acid, the sulphur was placed in the solution of the metal, the whole heated, though not to boiling, and then saturated with sulphurous acid gas. The solution was then boiled, allowed to cool, again saturated with sulphurous acid, and left to stand a couple of days in a closed flask. In every case, on opening the flask, there was still an excess of the metallic salt, and of sulphurous acid. To prevent oxidation, the substances, during washing, were kept covered with water as much as possible, and dried *in vacuo*. In none of them could any free sulphur be seen by the aid of the lens. Of each substance two preparations were made, in order to see if the composition of the substance remained constant.

For analysis, the substances were all dissolved by digestion with fuming nitric acid, which, in nearly every case, dissolved them completely, without separation of sulphur. The analyses of the copper compounds were made, in some cases, by precipitating the oxide of copper, at the boiling point, by caustic potash, and the sulphuric acid from the filtrate, after acidulation, by chloride of barium. In other cases, separate portions of substance were taken for the copper and sulphur determinations. The silver compounds were all analysed by precipitating, first the silver by chlorhydric acid, and then the sulphuric acid, from the filtrate, by chloride of barium.

Sulphide of Copper prepared by Boiling Sulphur with Acetate of Copper.

1st preparation.—0·6946 grm. substance gave 0·2817 oxide of copper, and 2·6436 sulphate of baryta.

2nd preparation.—0·3255 grm. substance gave 0·1479 oxide of copper, and 1·2938 sulphate of baryta.

* In all the following experiments the sulphur used was precipitated by sulphuric acid from hyposulphite of soda.

	I.	II.
Cu . . .	32·37	36·28
S . . .	52·27	54·56
	84·64	90·84

Sulphide of Copper obtained by the aid of Sulphurous Acid.

1st preparation.—I. 1·9560 grm. substance gave 1·3145 oxide of copper.
II. 1·7321 grm. substance gave 1·1615 oxide of copper.
III. 0·6727 grm. substance gave 2·0356 sulphate of baryta.

2nd preparation.—I. 1·8346 grm. substance gave 1·4830 oxide of copper.†
II. 2·2385 grm. substance gave 5·4626 sulphate of baryta.

		I. III.	II.
1st prep.	Cu . .	53·76	53·54
	S . .	41·54	
		95·30	

			Calculated.	I. II. Found.
2nd prep.	Cu . .	31·7	66·46	64·54
	S . .	16·	33·54	33·51
		47·7	100·00	98·05

Sulphide of Silver prepared by boiling Sulphur with Nitrate of Silver.

1st preparation.—I. 2·0266 grm. substance gave 1·6800 chloride of silver, and 4·9156 sulphate of baryta.
II. 1·3725 grm. substance gave 1·1359 chloride of silver, and 3·2839 sulphate of baryta.

2nd preparation.—0·4670 grm. substance gave 0·3519 chloride of silver, and 1·4593 sulphate of baryta.

		I.	II.
1st prep.	Ag . .	62·39	62·28
	S . .	33·31	32·86
		95·70·	95·14

			Calculated.	Found.
2nd prep.	Ag . .	108	57·45	56·70
	5S . .	80	42·55	42·91
		188	100·00	99·61

The formula CuS, derived from one of the above analyses, is probable enough. The formula AgS_5 is not a probable one, and the substance is perhaps a mixture of the ordinary sulphide of silver with unchanged sulphur. No sulphur, however, could be seen by the aid of a lens. The substance was apparently a perfectly homogeneous, dark grey powder. Lumps of it, when crushed, had the same appearance.

† According to Rose (*Analytische Chemie*, ii. 187), in igniting oxide of copper, the filter may be burned along with the precipitate, and any suboxide formed may be reoxidised by means of the current of air, which may be directed into the crucible by means of the cover. This is probably true in most cases, but sometimes there may be considerable loss through reduction. In the above analysis, after weighing once, I ignited and weighed again. The substance had increased considerably, and only after ignition in a current of air, of three or four hours in all, and a total increase in weight, from the first weighing to the last, of 0·0568 grm. (=3·1 per cent. of the substance analysed) was a constant weight obtained. On breaking up the lumps of oxide of copper, some red suboxide still remained, which had been protected from oxidation by the coat of protoxide on the outside. This would account, in part, at any rate, for the percentage of copper in the above analysis coming out too low. It is decidedly advisable to burn the filter separately. This was done in my other analyses, with one exception, in which, from its close correspondence with another analysis, little or no loss appeared to have been incurred.

It will be seen that, in the analyses of the above substances, two preparations excepted, there is a large loss, if the substances be supposed to consist only of sulphur and metal. That this loss is not owing merely to incorrect analyses, is shown by the pretty close correspondence of the analyses of the first preparation of sulphide of silver and of two of the copper determinations. I at first supposed that the sulphides had partly oxidised to sulphates; but, on heating them, first with water and then with dilute sulphuric acid, either none at all or only a trace was dissolved. Any sulphate, or other salt of silver or copper with the sulphur acids, should have dissolved up in the dilute acid. Heated in a dry test-tube, none of the substances gave any water. These facts led me to suppose that perhaps the presence of an oxysulphide, either alone or mixed with a sulphide, might not be impossible. On examining the analyses in which there was a loss, I find that the analysis of one of the sulphides of copper corresponds closely to the formula $CuOS_3$.‡

		Calculated.	Found
Cu . . .	31·7	36·15	36·28
O. . . .	8·	9.12	
3S . . .	48·	54·73	54·56
	88·7	100·00	

This formula is an improbable one, and I regret that I had not the time to investigate the subject further.

The analyses of the other sulphides did not correspond to any formula. When carefully examined under a lens, the copper compounds appeared to contain two substances. At first they appeared to be simply composed of a deep blue or blue-black powder. On breaking some of the lumps, however, these latter were found in many cases to be composed of a hard, light-coloured substance, with a reddish tinge, and somewhat metallic appearance. Its appearance was very much like that of protosulphide of iron which has been fused and then broken. The substance, which corresponded to the formula $CuOS_3$, was almost perfectly homogeneous, and was different in colour from the other copper compounds. It was dark grey, nearly black, without the bluish tinge of the others. The sulphides of silver were dark grey, one nearly black, the other considerably lighter. Both appeared to be perfectly homogeneous.

With regard to the manner in which the sulphides are forming by boiling sulphur with the salts of silver and copper, it might be supposed that one portion of the sulphur would be oxidised at the expense of the oxide of the metal, while another portion of sulphur would unite with the metal thus set free. Whether this is the case or not appears to be somewhat doubtful. After boiling sulphur a long time with solutions of acetate of copper and nitrate of silver until the sulphur was well blackened, the filtrates were tested for sulphuric acid. In the copper solution none was found; in the silver, only a trace. Another portion of each filtrate was then tested for other acids of sulphur, by boiling with nitric acid and then adding chloride of barium. No sulphur separated on adding the acid, and chloride of barium gave merely a trace of sulphate of baryta in the silver solution; none in the copper solution. It is possible

‡ The oxysulphides already described are ZnO, ZnS, CoO, CoS, and MnO, MnS, described by Arfvedson (Pogg. 1), $AsOsS_2$, by Bouquet and Cloez (*N. Ann. de Chim. et Phys.* 13, 14; *J. der Pharm.* 7, 23), and red antimony ore, $SbO_3,2SbS_3$. Of all these, the only one, the composition of which bears much resemblance to the formula ($CuOS_3$), is the arsenic compound; and from the wide dissimilarity between arsenic and copper, this analogy is but of little value as a proof of the probability of the above formula.

that the sulphur may be oxidised to sulphurous acid. No smell of this could be detected during boiling; but, as the action of the sulphur is not very rapid, the sulphurous acid may have been given off in too small quantity to have been detected. Against this hypothesis, however, are the following considerations:—As has been shown, sulphurous acid and other reducing agents greatly assist the formation of the sulphides, and this can be owing only to their reducing power. Now, if the sulphur be oxidised to sulphurous acid, some of this latter would be oxidised to sulphuric acid, of which, in the copper solution at least, not a trace could be detected. If the sulphur is not oxidised, and no reducing agent be present, it would seem that one of two suppositions must be adopted: either the sulphur sets the oxygen of the oxide free, which, I take it, is highly improbable, or the oxygen still remains in combination with the metal, and an oxisulphide is formed. The substances no doubt vary with the circumstances under which they are formed—length of time in boiling, concentration of solution, &c., —since two of the analyses made agree with the formulæ of sulphides, without oxygen. One of these was formed with the aid of sulphuric acid. In the other, it may be supposed that the sulphur, perhaps, in this case acted as a reducing agent.

II. *Action of Sulphurous Acid on the Solutions of Copper.*

As sulphurous acid was used in forming several of the compounds above described, I deemed it advisable to make some investigation into the action of sulphurous acid alone on the solutions of copper used.

Sulphurous acid, in most cases, produces no effect on the compounds of copper with the stronger acids. Under certain circumstances, however, a solution of sulphate of copper gives with sulphurous acid a small quantity of the well-known red sulphite of protoxide and suboxide of copper ($CuO,SO_2 + Cu_2O,SO_2 + HO$, Rammelsberg), and in other cases small crystals of metallic copper.§

The action of sulphurous acid upon acetate of copper does not appear to have yet been observed. I found that sulphurous acid gas passed through a solution of acetate of copper, heated, though not to boiling, gave at first a yellowish precipitate. This dissolved up again as the operation was continued, and the solution deposited a large quantity of small bright red crystals. The reactions of these corresponded to those of the red sulphite mentioned above. This gives, therefore, a new method of preparing the above salt.

The yellowish precipitate just mentioned may also be obtained by adding sulphurous acid water, in small quantity, to a solution of acetate of copper which contains little or no free acid. After washing and drying, it was of a yellow colour, with a slight greenish tinge. It appeared to be entirely insoluble in water. No crystals could be detected by the lens.

With sulphuric acid it gave off sulphurous acid in large quantity. By solution of caustic potash it was converted into a bright green, insoluble substance.‖ By boiling with caustic potash, it gave black oxide of copper. A portion dried *in vacuo* over sulphuric acid gave off considerable water on heating in a closed tube. It was found to contain no alkali, and no acetic acid.

For analysis, the salt was boiled with chlorine water until it dissolved, the sulphuric acid precipitated by chloride of barium, the excess of chloride of barium by sulphuric acid, and the oxide of copper, at the boiling point, by caustic potash.

1·2266 gramme substance gave 1·0341 sulphate of baryta, and 0·6975 oxide of copper.

		Calculated.	Found.
$2CuO$	79·4	57·37	56·86
SO_3	32·	23·12	23·15
$3HO$	27·	19·51	
	138·4	100·00	

The salt is very soluble in sulphurous acid, to a green solution. The latter, by standing, deposits the red sulphite. Acetic acid has a precisely similar effect. In preparing the salt, therefore, the solution of acetate of copper must be neutral, and the sulphurous acid added in small quantity. If too much acid be added, the precipitate will be redissolved, even before the solution smells of sulphurous acid.

The salt appears to be hitherto undescribed. The only mention I can find of anything similar is in a paper on the sulphites, by Böttinger.

Böttinger,¶ by mixing a solution of sulphate of copper with sulphite of ammonia, containing but a small quantity of free sulphurous acid, obtained a dirty, greenish-yellow precipitate, which, on the addition of a little sulphurous acid, was rapidly and easily converted into a beautiful green liquid. This yellow precipitate he did not investigate further. I prepared a quantity of it for comparison with the salt which I obtained. The colour of the two substances varied considerably from each other. That obtained by means of sulphite of ammonia was brownish-yellow, with little or no greenish tinge. That prepared from acetate of copper was of a much brighter yellow, with a decided tinge of green. Böttinger's salt, however, gave precisely the same reactions as mine. With strong acids it gave off sulphurous acid in large quantity. With caustic potash it became brigh green. By boiling with caustic potash it became black, and gave no smell of ammonia. The two salts, therefore, are no doubt identical.

III. *Action of Red Selenium on the Solutions of Copper, Silver, and Lead.*

1. Without the Presence of Reducing Agents.—Red selenium, left four days in solutions of sulphate and acetate of copper, still remained red, showing that it had not combined with copper. The same, boiled with sulphate of copper, for a long time, did not take up any copper. Boiled with acetate of copper, however, it was found to have united with considerable copper.

For analysis of the product of this last reaction, red selenium was boiled several hours with acetate of copper, thoroughly washed, and dried *in vacuo*. The substance obtained was a black powder, mixed with hard lumps, which, when broken, had a somewhat metallic lustre. For analysis, it was dissolved in nitric acid, the oxide of copper precipitated, at the boiling point, by caustic potash, washed, dried, and ignited with saltpetre and carbonate of potash.

0·5237 gramme substance gave 0·0507 oxide of copper.

		Equivalents.
Cu	7·73	1
Se (by difference) .	92·27	9·7
	100·00	

§ Wöhler, *Ann. der Chem. u. Pharm.*, lxxix. 126—127.

‖ The green colour was owing, probably, to the presence of a little hydrated suboxide of copper, the yellow colour of which, with the blue of the hydrated oxide, would give green.

¶ *Ann. der Chem. u. Pharm.*, li. 410

Hence it would seem that the selenium was only partly converted into selenide of copper, notwithstanding that the boiling was kept up five hours, or more.

Red selenium, left four days in solution of nitrate of silver, gave a black powder, along with a few white flakes of (probably) selenious acid. After dissolving out the latter by means of caustic soda, the black powder was found to contain selenium and silver, both in large quantity. No free selenium could be seen in it by the aid of the lens.

Red selenium, boiled a long time with acetate of lead, took up no lead.

2. With the Aid of Reducing Agents.—As already mentioned, red selenium, with sulphate of copper and sulphurous acid, becomes black, through formation of selenide of copper.

For analysis, a portion was prepared in the same manner as the corresponding sulphide of copper. The product obtained was a black powder, nearly homogeneous, but containing a few glistening particles, which looked like metallic copper. The substance was dissolved in nitric acid, and the oxide of copper precipitated as usual by caustic potash. The separation of copper and selenium in this manner is not quite perfect, a little selenious acid being usually precipitated along with the oxide of copper. Accordingly, the copper in the following analysis comes out somewhat too high.

2·0735 gramme substance gave 0·8336 oxide of copper.

		Calculated.	Found.
2Cu	63·4	61·61	62·00
Se	39·5	38·39	
	102·9	100·00	

This same compound may also be formed by heating copper with selenium, or by igniting the protoselenide in a closed vessel. (Berzelius.) It is also found native.

Red selenium, boiled half an hour with acetate of lead and acetate of the protoxide of iron, did not take up any lead.

(To be continued.)

On Methylamine, by M. Carey Lea.

Production and Separation of Methylamine.

In a previous paper I have pointed out that ammonias in which hydrogen is replaced by methyl are obtained by the action of nitrate of methyl upon ammonia at ordinary temperatures. Nitrate of methyl, obtained by the distillation of methylic alcohol with nitric acid and urea, is placed in well stoppered bottles filled only about one quarter, together with a little more than its own bulk of thoroughly saturated aqueous ammonia, and is left till the nitrate of methyl disappears, or until only a few brown oily drops remain,—a reaction which requires from three to six days, according to the temperature. The liquid is then distilled with caustic alkali, and the gaseous products are conducted into water.

In this solution we should by analogy expect to find ammonia, methylamine, dimethylamine, and trimethylamine, and it remains to separate these bases. This is a matter of extraordinary difficulty, much surpassing that of the separation of the ethyl bases. In the ethyl series the bases differ from each other and from ammonia by C_4H_4, whereas in the methyl series the successive terms acquire the addition of C_2H_2 only. Naturally, therefore, we must look for greater similarity in character and corresponding difficulty in separation. Accordingly, the methods which give such satisfactory results with the ethyl ammonias fail entirely with the methyl bases. Ammonia cannot be separated from them by a difference in the solubility of the sulphates in alcohol. When the mixed solution is neutralised with sulphuric acid and exhausted with alcohol, little or nothing is removed by it. Nor can the separation be effected by means of picric acid, although that substance may be used in one particular case mentioned below.

This problem I have as yet been able to resolve only in part. Two steps I have accomplished; first, the complete removal of the ammonia from the mixed methyl bases; and second, the isolation of the methylamine in a state of purity. The separation of the more substituted bases still remains to be accomplished.

It is, however, satisfactory to have a process for obtaining perfectly pure methylamine without resorting to the troublesome reaction of the cyanate of methyl, and that much has been effected. After the compound ether has been completely decomposed by the ammonia, the contents of the bottles are to be distilled with caustic alkali or lime. The solution of the mixed bases and of ammonia is to be exactly neutralised with oxalic acid, and the water driven off as far as possible by being heated over the water bath. The resulting mass is transferred to a flask, and boiled a few minutes with a large quantity of alcohol of density 42° B., and after cooling and standing some hours it is filtered. The whole of the ammonia remains as oxalate upon the filter. The filtrate by spontaneous or gentle evaporation separates into two layers. The lower, which is much the least in quantity becomes very soon crystalline; indeed, this change takes place so rapidly that the fluid stage may easily pass unnoticed. More oxalate of methylamine remains in the mother liquid, and separates on further evaporation.

After the fluid has crystallised, the resulting pearly white laminæ are purified by boiling with absolute alcohol, or with a mixture of equal parts of alcohol of 42° B. and ether, and this is repeated three or four times, allowing a thorough cooling to take place between each operation. The oxalate of methylamine finally crystallises out quite pure, and methylamine may be obtained from it directly by distillation with caustic alkali. But the distillation is extremely unpleasant, exhibiting the phenomenon of percussive ebullition to such a degree as to endanger the whole apparatus, and to drive the liquid out of the Woulfe's bottle in strong jets through the safety tube. It is therefore advisable to treat the oxalate with nitrate of baryta or chloride of barium, leaving them in contact for a day to evaporate the filtrate, and then distil. I give the preference to the nitrate of baryta, because the nitrates of the ammonias distil more quietly than any of the others of these salts.

The methylamine thus obtained was converted into chloroplatinate and analysed.*

1·0105 grm. gave of Pt. . . . . ·4216

This corresponds to (per cent.) . . 41·72

Theory requires for $\left.\begin{matrix}C_2H_3\\H\\H\\H\end{matrix}\right\}NCl.PtCl_2$. 41·62

The residue after the greater part of the oxalate of methylamine had crystallised out was evaporated, exhausted with absolute alcohol, treated with nitrate of baryta, distilled with caustic soda, and neutralised with picric acid. From this solution there crystallised out

* It is scarcely necessary to observe that if platinum salts are recrystallised the results of their analysis cannot be taken as a proof of the accuracy of the mode of separation used. In the analyses here published care was taken to use in all cases an excess of bichloride of platinum, and to include the whole precipitate in the analysis.

beautiful amber-coloured beveled prisms and hexagonal plates, greatly resembling the pierate of ethylamine, and apparently isomorphous with it. These were converted into chloroplatinate, and analysed with the following result:—

·7265 grm. chloroplatinate gave of Pt. . ·3025
This corresponds to (per cent.) . . 41·65
Chloroplatinate of methylamine contains . 41·62

The substance was therefore pierate of methylamine.

The residue appeared to be a mixture. Analyses of different portions from different crystallisations gave respectively 39·85, 40·14, and 40·23 per cent. of platinum in the chloroplatinate, nor could any satisfactory means of separation be found.

Reactions of Methylamine.

Many of the reactions of methylamine have been already described by its discoverer, M. Wurtz. To these may be added the following:—

Cerium, protochloride—A white precipitate, insoluble in an excess of the precipitant.

Cerium, nitrate of proto-peroxide—Dirty white, insoluble in excess of precipitant.

Zirconium, sulphate of zirconia—White, insoluble in excess.

Aluminium, alum—A white precipitate, which redissolves in an excess of the precipitant.

Antimony, terchloride—A red-brown precipitate, insoluble in excess of precipitant.

Glucinum, sulphate of glucina—A white precipitate, insoluble in excess of precipitant.

Molybdenum, protochloride—No precipitate.

Molybdenum, bichloride—Reddish precipitate, insoluble in excess of precipitant.

Palladium, protochloride—Abundant flesh-coloured precipitate, insoluble in excess of precipitant.

Ruthenium, sesquichloride—Brown precipitate, insoluble in excess of precipitant.

Platinum, protochloride—No precipitate.

In describing the reactions of diethylamine I pointed out that the remarkable property of dissolving alumina, hitherto considered as characteristic of ethylamine amongst the ammonias, was shared by diethylamine. It now appears that it is possessed also by methylamine, and it would not be surprising if it were found to extend to the other methyl and ethyl bases, and even to the bases containing other alcohol radicals,—a point which I propose hereafter to examine.

The deportment of methylamine towards solutions of protochloride of molybdenum is characteristic, and differs from that of ammonia, ethylamine, and diethylamine.

Methylamino-chloride of Palladium.

When aqueous methylamine is added in excess to solution of protochloride of palladium, or to a solution of the following salt, at the first moment no precipitation takes place, but in a few moments a quantity of flesh-coloured needles are formed. These were dried over sulphuric acid and ignited.

·2049 substance gave metallic palladium ·0969.

From which we find:—

		Calculated.	Found.
2C	12	9·32	
5H	5	3·88	
N	14	10·88	
Pd.	53·3	41·38	42 45
Cl.	35·5	27·56	
HO	9	6·98	
	128·8	100·00	

leading to the formula $C_2H_5NPdCl + HO$.

The palladium is a little in excess, because with the small quantity of material at command it was impossible to wash out the not entirely insoluble precipitate thoroughly without too great a loss.

Chloro-palladite of Methylamine.

When methylamine is added, not in excess, to an acid solution of protochloride of palladium, or when the foregoing salt is treated with an excess of the same acid solution, a deep brown-red liquid is obtained, which by concentration yields beautiful brown-red laminæ, very soluble in water and in alcohol. The quantity at command was insufficient for analysis, but, judging from analogy, their constitution must be $C_2H_6NCl,PdCl$.

Picrate of Methylamine.

This is a very beautiful salt. It crystallises in bright yellow laminæ grouped in fine arborescent clusters, or by somewhat slower crystallisation, in amber-coloured beveled prisms and hexagonal plates. Heated on platinum foil it deepens in colour, melts to a clear red liquid apparently without decomposition, and when the heat is further raised burns with a vivid white light, leaving a carbonaceous residue. It is moderately soluble in water and in alcohol.

Other combinations of methylamine will be described at a future time.—*American Journal of Science.*

On the Decomposition of Oxalic Acid by Light, by M. W. SEEKAMP*.

A SOLUTION containing 5 per cent. of oxalic acid and 1 per cent. of uranic nitrate does not decompose in the dark even at 100°; but on being exposed to the light, it disengages a gas containing from 56 to 57 per cent. of carbonic acid and from 42 to 43 per cent of oxide of carbon. At the same time a slightly soluble green powder of uranous oxalate is precipitated. This precipitate is composed of microscopical, prismatic, square-based crystals, apparently identical with the product obtained by M. Peligot in precipitating chloride of uranium by oxalic acid. A little formic acid is at the same time produced by the combination of nascent oxide of carbon with water.

$$\left.\begin{matrix}C_2O_2\\H_2\end{matrix}\right\}O_2 = CO_2 + CO + H_2O.$$

Oxalic acid.

$$\left.\begin{matrix}C_2O_2\\(Ur_2O)_2\end{matrix}\right\}O_2 + 2C_2H_2O_4 = 2\left\{\begin{matrix}C_2O_2\\Ur_2\end{matrix}\right\}O_2 + 2CO_2 + 2H_2O.$$

Uranic oxalate. Uranous oxalate.

Succinic acid is also decomposed under the influence of light; but this subject will be treated separately.

On Native Zinc and Native Tin, by Dr. T. L. PHIPSON, *F.C.S., &c.*

HAVING been requested to give a description of the Australian minerals exhibited by the various Australian Colonies in the International Exhibition, I was surprised to find in this magnificent collection a specimen of native zinc. This is the first time that this metal has been met with in nature in the pure state. The specimen, weighing perhaps ten or twelve grains, is incrusted in a piece of basalt, from Brunswick, near Melbourne, Victoria.

* *Annalen der Chemie und Pharmacie*, vol. cxxii. p. 113 (New Series, vol. xlvi.).

Concerning native tin, it is evidently very rare in nature. Some years ago, I noticed some small white grains in a sample of platinum ore from the Ural, which appeared to be metallic tin. Hermann had already met with this metal, in small white grains, in the gold deposits of Siberia, and, recently, M. Damour found it accompanying some gold nuggets from Guyana. These nuggets contained nearly 42 per cent. of platinum, also silver and copper. One of them was observed to have adhering to its surface, and in some of its cavities, a greyish-white ductile metal which was proved to be metallic tin.

The above leads me to infer that the supposed new element noticed in the platinum ore of Rogue River, Oregon, by Mr. Chandler, and in the platinum ore of California, by Dr. Genth, as stated in a recent Number of the Chemical News, is simply metallic tin. The more so, as these authors state that the metal in question is malleable, easily fusible, soluble in hydrochloric acid, from which solution it is precipitated as a brown sulphide by sulphuretted hydrogen, or by zinc as a metal resembling metallic tin.

On Sombrerite, by Dr.* T. L. Phipson, *F.C.S., Member of the Chemical Society of Paris, &c.*

This mineral forms a large portion of some small islands in the West Indies, especially of Sombrero Island (N. lat. 18° 35′, W. long. 63° 28′), about sixty miles from St. Thomas. Its composition and properties prove it to be a new species, to which I have given the name "sombrerite." It is remarkable for the large proportion of phosphoric acid it contains.

Sombrerite presents itself in nature as a white, yellowish-white, or reddish coloured rock, having a straight fracture, and, in some portions, a peculiar horny aspect; its appearance is, in general, compact, though, in reality, the rock is very porous. It shows no signs of crystallisation whatever, but appears like an amorphous, gelatinous phosphate that has been submitted to a high temperature. It is thought to be of comparatively recent geological origin, as it encloses fossil bones (of mammalia?), and several kinds of shells. In a mineralogical point of view, sombrerite is a compound of phosphate of lime with phosphate of alumina; in some specimens a portion of the alumina is replaced by a corresponding proportion of sesquioxide of iron; in others, where little or no iron is present, the mineral adheres to the tongue like other aluminiferous minerals. Sombrerite is not phosphorescent by heat, like apatite; before the blowpipe, when moistened with sulphuric acid, it colours the flame pale green. It contains no fluoride or chloride of calcium.

The specific gravity of sombrerite is 2·52. A well-chosen specimen has given me the following composition:—

		Atomic ratio.	
Water	9·00	1·00	20
Phosphate of lime $\dot{C}a_3\dot{P}$	65·00	0·41	8
Phosphate of alumina $\dot{Al}_2\dot{P}_3$	17·00	0·05	1
Carbonate of lime	5·00		
Chloride of sodium	1·44		
Sulphate of lime	1·36		
Silica	1·00		
Crenate of ammonia, &c.	0·20		
	100·00		

* *Journal of the Chemical Society.*

The formula of sombrerite is, therefore, $3\dot{C}a_3\dot{P} + \dot{Al}_2\dot{P}_3 + 20\dot{H}$.

Persons who have seen this rock think that it owes its origin to guano, some looking upon it as "fossil guano," and others as "guano modified by volcanic action." In order to bring forward, if possible, some proof of these theories, I took a large quantity of the mineral, and sought carefully for uric acid. Though the experiment was repeated several times, I have not been able to find the least trace of that compound, but only a very small quantity of crenate of ammonia, which I have frequently met with in many other minerals, notably in iron ores of various ages. At the same time, it is possible that sombrerite may have derived its origin from ancient deposits of guano, modified by time and geological phenomena, as we see large beds of limestone and sandstone almost completely formed by the *débris* of organised beings. However that may be, I look upon this rock as having found its way to the surface at a high temperature, in contact with water or steam, and under great pressure. This would account for its peculiar appearance.

As regards the uses of sombrerite, I believe it has been employed already for the preparation of phosphorus, phosphoric acid, &c. But for agricultural purposes, though doubtless valuable, it presents a drawback to the manufacturer of "super-phosphate of lime." In producing the latter, sombrerite gives rise to a certain quantity of sulphate of alumina, and this salt being deliquescent, attracts and retains so much moisture that the product can be dried only with great difficulty.

Sombrerite has, however, the advantage of being easily reduced to powder, and could, in that state, be advantageously mixed with certain soils.

TECHNICAL CHEMISTRY.

On a New Process for the Preparation of Phosphorus, by M. Cari-Montraud.

Taking advantage of the long-established fact of the decomposition at a high temperature of dry phosphate of lime mixed with carbon by hydrochloric acid, M. Cari-Montraud founds upon this reaction a new process for the preparation of phosphorus.

Calcined bones finely powdered are mixed with sufficient pulverised wood charcoal to convert all the oxygen of the tribasic phosphate of lime into oxide of carbon. The mixture is put into fire-proof earthen cylinders, glazed inside, which are three parts filled. These cylinders being made red-hot, a current of hydrochloric gas is passed in at one of the extremities.

Under these circumstances the phosphate of lime decomposes immediately. Chloride of calcium, oxide of carbon, hydrogen, and free phosphorus are formed.

The phosphorus is distilled, and is conducted, together with the oxide of carbon, the hydrogen, and the excess of hydrochloric gas, by means of a copper adapter, into a vessel filled with cold water, where the phosphorous vapours are condensed. The water of this refrigerating condenser becoming very acid by the absorption of the excess of hydrochloric gas, is utilised by putting into it the calcined bones, where they are dissolved or softened, rendering pulverisation unnecessary.

The magma resulting from this maceration is mixed with carbon, and the whole evaporated to dryness before being put into the cylinders.

Hydrochloric gas is produced by the decomposition of sea-salt by sulphuric acid. The chloride of calcium forming the residuum in the cylinders can also be utilised by treating it with sulphuric acid, which regenerates the hydrochloric gas, whilst the lime is converted into sulphate of lime, which is useful for manure. Chloride of calcium can also be decomposed by aqueous vapour.—*Moniteur Scientifique.*

On the Cleaning and Preservation of Engravings.

Augustus A. Hayes, M.D., State Assayer of Massachusetts, says in the *Scientific American*:—

The frequent inquiries addressed to me by those who possess valuable engravings—which have become damaged through accident or exposure—respecting a mode I adopted successfully for restoring some very fine ones, induce me to publish a general process applicable to the largest number of cases.

Any one who will incur the trouble of looking up in the older print shops and depositories in residences in this country, will find abundance of defaced engravings of rare merit, the works of the best masters rejected, which can be restored easily to quite their former degree of freshness and beauty. All who have studied the better efforts of the old artists in giving permanency to their conceptions in this department of art, assign to it a very high place, and it may be suggested that a higher cultivation and enjoyment of design and execution, in so far as the influences of light are concerned, may be gained from careful observation of engravings than can result from time bestowed on paintings which often command public admiration, or are the so-called gems of an exhibition.

In commencing to restore an engraving, some attention must be given to the kind of injury it has suffered. A general brown colour, more or less deep, resulting from atmospheric action only, is the least possible change. Spots and stains caused by ink, coloured fluids, oil, or insects must be first treated, and all pencil marks removed by india-rubber or bread crumbs. A fluid acid, obtained by dissolving one ounce of crystals of oxalic acid in one-fourth of a pint of warm water, may be used for application to all stains, and the paper should be wet with it thoroughly where spots of any kind exist. Excepting in a few cases, this acid will not cause the removal of stains immediately, but generally it combines with the bases of them, and they are removed by subsequent steps; the thorough wetting should be done a few hours before proceeding to clean the engraving.

To facilitate handling and for the protection of the edges of the paper, a piece of millinet, or the stiff open fabric formerly sold for ladies' skirts, should be roughly sewed around one stick at each end, so as to form an apron, like a chart attached to two rollers, the cloth of which must be an inch larger than the largest print to be handled. From one to ten prints of even large size may be cleaned at one time, after they have been wet on their spotted parts with the acid, and evenly spread on the apron, so as to allow of the immersion of the whole in water. A tub of the ordinary size will allow prints of considerable surface to become immersed, but the most desirable resort is a common bathing vessel, so nearly filled with warm water that the bent paper supported by the open texture can rest on the bottom and sides, where it should be allowed to remain, with occasional raising of it, and moving it by means of the stick handles, from twelve to twenty-four hours.

On the first trial a degree of alarm will be felt in the case of a highly-prized favourite at this seeming careless treatment; but it must be borne in mind that paper is a firmly felted mass of short fibres which may be soaked in various fluids for weeks and resist all diluted acids and most chemical agents for a long time wet, if not exposed to mechanical abrasion by touch or rapid motion. The strong paper of engravings absorbs much air, which resists the penetration of the water, and motion is necessary to remove this as well as to allow the coloured solutions formed to pass away. This motion may be given by holding the supporting sticks and passing the mass from end to end of the bath, or slowly up and quickly down, enabling the sheets to become separated momentarily. Discoloured water may be drawn off, the apron and contents resting on the bottom and sides, and fresh water be slowly admitted to replace it. Cold water can be substituted for warm, longer time being allowed for its action. When the prints no longer add colour to the water after being agitated, the water must be withdrawn and replaced by such a portion as will barely cover the paper. Half a pound of bleaching powder (chloride of lime) mixed to a paste first in cold water, and then added to two quarts of cold water and well stirred from time to time for six hours, will afford a nearly clear fluid resting on a white deposit in the earthenware vessel. A portion of the clear part of this fluid must be added to the water in the bath, until both taste and odour denote the presence of chlorine in the water. Motion being given to the paper, the bleaching effect of chlorine will be perceived, or its odour in the water will have been lost, when more must be added so that the odour or taste of chlorine must be present in the water two or three hours.

The action of the chlorine on the parts previously wet with the acid will remove nearly every kind of discoloration, while the brown hue of the paper giving place to perfect whiteness, the light and shadows of the engraving become of their original perfectness, and the picture will be as distinct as when it was first impressed. It has happened in a few trials, when the prints were long stained, they did not yield to the weak chlorine water, that resort was to have a little mineral acid to develope free chlorine in the bath. One ounce of muriatic acid was added to one pint of cold water, and the weak acid thus formed mixed in the water of the bath, soon caused the bleaching of every fibre in the paper.

After the bleaching the water must be drawn off, the paper drained, fresh clear water admitted, and the paper moved through the water to thoroughly wash away all adhering chlorine. Several quantities of water may be used, the paper being each time drained; and finally, the whole mass, raised by the handles, may be placed on a clean white wood table or board to drain. If a number of prints have been treated, the wet mass may be placed in a warm room, or air may be admitted, and as the one on the top of the pile becomes more dry than the rest, it may be removed to any support and left to dry. In hastening the drying I have extended ordinary bed sheets and spread the wet prints singly on these, slow drying rendering any pressing unnecessary.

Those having the usual presses might prefer to press the still damp sheets, and where only two or three prints are the subjects of trial, the substitution of other vessels and ready appliances will occur to any one.

This description is given in detail purposely, although unnecessary, so far as the process is concerned, because I wish to impress on the mind of any one who possesses

an injured engraving that it can be restored to its original value without the expenditure of much attention; and it must not be the conclusion, from reading this process, that great care is required, for time is insisted on rather than attention. The few dispositions being made, not the slightest care need be given to the matter. If the bath can be spared, the odd minutes of a week will enable one to restore dozens of specimens, and give permanency to their beauties.

PHARMACY, TOXICOLOGY, &c.

Medico-Legal Contributions on Arsenic, by Charles H. Porter, *M.D.,* Professor of Chemistry and Medical Jurisprudence, Albany Medical College.*

Intending in this paper to report a number of cases of arsenical poisoning, it has been deemed advisable to preface them by an account of the methods pursued for the detection or the poison. This is done for the reason that, when the details are given, each one may judge for himself as to the degree of reliance to be placed upon the results, and also because medical men generally are not acquainted with the minutiæ of such examinations.

It may also be said that while the special works on poisons contain detailed information regarding the various tests, they are deficient in any systematic method of procedure applicable to those cases where the particular poison is unknown.

Aside from text-books on chemical analysis, and a single one on the detection of poisons, there is nothing easily accessible to medical men in this country that furnishes detailed information upon this subject. The design of the first part of this paper (which bears no claim to originality, but is a compilation from various sources), then, is to give the method pursued in the investigation of the cases hereafter reported—a general mode of procedure in all cases of metallic poisoning (ensuring the detection of the various toxical agents), with special reference, however, to arsenic; and again give a systematic plan, whereby the material can be most properly prepared for obtaining the various tests, together with the brief description of the more characteristic chemical reactions for arsenic.

Part I.—The Detection of Arsenic.

I. *General Considerations.*

1. Chemical Evidence.—The chemical evidence in cases of supposed poisoning is generally regarded as the least fallacious of all branches of proof. Owing to the labours of Orfila, Fresenius, Otto, Stass, Flandin, and others in the detection of poisons, the subject has become so far developed that, in the majority of cases, a charge of poisoning may be satisfactorily decided by the results of a chemical examination. This opinion is entertained not only by professional chemists, as well as by intelligent medical men, but also by courts of justice, so that commonly the chemical detection of a poison is deemed necessary before a conviction can be obtained in a charge of poisoning.

But it must be said that not unfrequently too much reliance is placed upon chemical evidence, many deeming it unsafe to convict where this evidence is wanting. This is, however, a narrow view, and indicates an ignorance of toxical science. Simply because poison is found in certain remains, it does not necessarily follow that it was the cause of death; the symptoms and post-mortem appearances may prove the contrary; nor does the absence of poison in the dead prove that death was not occasioned by poison.

In this country, few, if any, individuals have been convicted of the crime of poisoning where the poison was not supposed to have been found in the body. In England, the celebrated Palmer case offers an instance to the contrary, and others might be mentioned. There seems to be no good reason (where other evidence is positive) why a conviction should not be obtained, even in the absence of chemical evidence; all that is necessary in such a case is to satisfy the jury that the deceased died from poison, and this occasionally may be done without, as well as with, the class of evidence we are speaking of.

The detection of poisons in the tissues generally, as well as in the intestinal tract, and in the food and medicine given, furnishes the most complete chemical evidence of poisoning; if only found in the stomach or in the food or medicine, the testimony is weakened because there is a possibility that it might have been placed there subsequently.

There are certain fallacies which must be guarded against in receiving evidence derived from chemical examinations in medico-legal investigations. It is not to be supposed that in all cases such examinations will be made by those most competent, and hence, besides the inherent difficulties of such researches, it is necessary to insure ourselves against the ignorance and unskilfulness of the operator. Thus we may allude to the meagreness or absence of characteristic tests for many organic poisons, and the difficulty of separating them from organic mixtures. Again, and this is more pertinent to the subject of this paper, it has been ascertained that many of the reagents, supposed to be pure, are often contaminated with poisons.

Thus, arsenic is often found in zinc, sulphuric acid, and chlorhydric acid, and in other materials used in toxical investigations. The knowledge of this fact causes us to doubt whether the arsenic discovered in minute quantities in many reported cases, was contained in the remains examined or in the chemicals used. The above remarks illustrate the great danger there is in relying upon the supposed detection of minute quantities of poison, in the absence of physiological and pathological evidence, and without a careful examination by competent authority of the methods followed in operating upon the materials examined.

Before treating of the methods of analysis, a few remarks may be made concerning the—

2. Physical Examination of Materials for Analysis.—Food, Contents of the Stomach, &c.—By a careful physical examination of these substances, poison may often be discovered. The best mode of procedure is to place a part of the suspected mass into a glass vessel, such as a beaker, and, after adding water, stir the whole with a glass rod. After allowing it to settle, pour off the water, without disturbing the sediment. To this water should again be added, and the operation repeated. In the bottom of the vessel may often be seen arsenious acid in the form of small white particles, which feel gritty, and grate under the glass rod. These are to be taken out and dried. As simple tests, one or more may be gently heated in a glass tube sealed at one end, and another in a similar tube with carbonate of soda. If in the first tube is produced a white crystalline deposit, and in the second a black metallic mirror, it is pretty decisive evidence of the existence of arsenic.

* Communicated by the author, having been presented to the Medical Society of the State of New York.

Stomach, Intestines, &c.—If the intestinal tract is to be examined, it should be completely opened, and its appearance carefully observed.

Very often particles of arsenious acid may be seen adhering to the mucous membrane, which may be tested in the manner just mentioned.

3. Division of Materials for Analysis.—Mechanical division facilitates chemical action; it is, therefore, proper to minutely divide organic substances before commencing their analysis. This may be done by a pair of scissors or small shears; but where a considerable quantity of animal matter is to be operated upon, a small new "meat-chopper" (consisting of an iron cylinder containing a set of revolving knives) may most conveniently be employed. By such an apparatus, in five or ten minutes, the various parts, as the stomach, intestines, liver, kidney, &c., may be converted into an almost homogeneous pulpy mass, and thus be in the best condition for being acted upon by chemical agents.

4. Necessity of a Preliminary Examination.—From what has already been said of the fallacies of chemical evidence, and the nature of the errors that may arise, it is evident that in cases of suspected poisoning the chemical examination ought only to be entrusted to experienced and reliable men. No amount of labour ought to be spared in such an examination in obtaining reliable results; for an error may cost a human life, and from the fact of impurities of a poisonous character occurring in our chemicals, &c., there exists, in my opinion, a real necessity for a thorough preliminary examination. Portions of animal or vegetable matter, as the case may be, equal in weight to the articles afterwards to be examined, ought to be taken and subjected, in the same vessels and apparatus, to the same processes, by the use of portions of the same reagents in as large a quantity as will afterwards be used in the actual examination.

If this examination shows the vessels and chemicals to be pure or free from poison, the analyst may at once proceed to the examination of the suspected material and, if otherwise, he will detect the impure materials and can replace them. Only after this procedure can the real examination be properly undertaken; the results will then be entitled to confidence, and all doubt will be removed from the mind of the examiner regarding the source of the poison, in case any is found; it will, besides, free him from many embarrassing questions when in the witness-box, which otherwise might seriously affect him.

It may be stated here that it was probably in consequence of arsenic occurring in the reagents employed in the investigations, and the omission of their preliminary examination, that led to Orfila's erroneous assertion that arsenic is a normal constituent of the human body. Because of this omission in the case of Mrs. Wooler, (Durham, England, Winter Assizes, 1855,) doubt was thrown on the scientific evidence by reason of the use of chlorhydric acid containing arsenic; the discovery of this impurity was not made until after the analysis was completed.

In every case investigated by me, a preliminary examination has been made in the way just mentioned. It is true that but a few poisons, of which the chief is arsenic, are likely to occur in the materials employed in analysis; occasionally, however, others are present, and as a general rule, therefore, it is advisable to make a preliminary examination.

5. Separate Examination of Each Part.—It is always desirable that each part be separately examined, —as, for instance, the stomach, the contents of the stomach, the small intestines, the large intestines, the liver, &c.; for often, by proceeding thus, important information may be obtained. It is best also to consume in the first examination but a part of the material (after the whole has been finely divided and intimately mixed) —two-thirds, for example,—so that, in case of accident, an examination may still be made; and to this there is usually no objection, since in almost all cases, if the poison can be detected in the whole, it can be in the part mentioned, and in sufficient quantity not only to identify it, but to make the greater number of the confirmatory tests.

6. Remarks on the Method to be Pursued.—It is not difficult to identify the various metallic poisons, when they are free from other substances, by the application of a few simple tests. Where, however, the poisons are in admixture with organic matter, the problem presented is of far more difficult solution, for the organic substances may prevent, modify, or conceal the characteristic chemical reactions which otherwise would take place upon the application of the different reagents. As most often the substances presented for toxical examination are articles of food or portions of the human system, toxicologists have devised many methods for the destruction or separation of the organic matter without any loss of poison. The method we prefer is proposed by Duflos (?) and elaborated by Fresenius and Babo. I speak from a somewhat large experience, and can say that, taking everything into consideration, it is far more reliable and satisfactory than any other that I have met with. In many cases forwarded to me for examination, I have not been informed of the circumstances attending the death, and have therefore sought for a method by which (after determining as far as possible the absence of organic poisons) none of the metallic poisons could escape detection, and have adopted that alluded to.

If the problem were always the simple one, "Is arsenic or is mercury contained in these remains?" other processes might possibly be more advantageously employed. Taylor, in his work on poisons, speaks depreciatingly of Fresenius and Babo's method as being elaborate and exhaustive, and says that (according to Orfila) its complications surpass all credibility. To this it may be replied that the process which the most distinguished chemists of the world approve, as Otto, Bocher, Wöhler, Silliman, &c., and which stands the test of years, must have great merit in it, or it would not be thus supported; in their opinion it is evidently the best that has been devised.

It is true that the process demands a considerable amount of chemical knowledge and skill in manipulation; it is elaborate and exhaustive; it is also accurate and reliable, and can be satisfactorily applied in any case.

It may be said that in many cases a physician or other person, who has not applied himself especially to the detection of poisons, may satisfactorily determine their presence. Undoubtedly this is true; but it seems to us most prudent, in cases involving a human life, to have the examination conducted by those who are experts and have made toxicology a specialty, for thus the fallacies attending all chemical processes in the hands of the inexperienced are removed.

We will now briefly give a—

II. *General Method for the Destruction of Organic Matter in the Presence of the Metallic Poisons.*

1. Decolorisation and Solution.—If much water

is present in the matter to be examined, it is desirable to concentrate it in a water bath, or at a temperature not exceeding 212° F.; it is then to be treated as indicated below.

Solid matter, such as the liver, stomach, &c., after being finely divided, is to be placed in a porcelain evaporating-dish, and mixed with chlorhydric acid and water until it forms a thin paste. It is neither desirable nor necessary to use a very strong acid; an acid having the density of 1·11 is sufficient. The dish is then to be placed upon a water bath, or over a lamp, and gently heated at a temperature not exceeding 180° F. Chlorate of potash is then to be added, in portions of from ten to twenty grains, every five minutes or thereabouts, occasionally stirring the mixture until the whole is converted into a light yellow homogeneous liquid, when it is allowed to cool. (The fatty matters are with difficulty destroyed, nor is their decomposition generally absolutely necessary; they solidify upon cooling, and are easily removed.) The liquid is now to be placed upon the sand bath, and heated until the smell of chlorine has disappeared. By the action of the chlorhydric acid upon the chlorate of potash, chlorine compounds are evolved, which decompose the organic matter, and convert any arsenic that may be present into arsenic acid. After cooling, the liquid is to be filtered, and the filtrate carefully preserved; the residue remaining upon the filter is to be thoroughly washed, and the washings collected in a separate vessel; if in large quantity they may be evaporated to the bulk of three or four ounces, and are then to be added to the original liquid. (The residue may contain sulphate of lead.)

2. Treatment by Sulphydric Acid (H S).—The mixed fluid is poured into a beaker glass, and a slow stream of washed sulphydric acid passed through it for twelve hours; it is then to be allowed to remain at rest for the same length of time. This treatment precipitates any arsenic, mercury, antimony, copper, &c., that may be present in the form of the corresponding sulphide, together with a portion of organic matter. The liquid is afterwards filtered, and the precipitate washed until a small portion of the washings gives no precipitate with nitrate of silver, thus indicating the absence of chlorine. (The filtrate and washings may contain zinc, &c.).

The production of a precipitate by sulphydric acid does not of itself indicate that any metals were in solution, since organic matter, even if alone, is precipitated under these circumstances.

3. Purification of the Precipitate.—It is to be particularly noted that in order to obtain satisfactory results, all the materials used in the following operations must be free from chlorine, otherwise a portion or the whole of the arsenic, according to the quantity present, will be converted into the chloride and may be volatilised. If the precipitate by sulphydric acid be of a yellow colour, it may contain arsenic, antimony, or tin; if of a dark colour, approaching to blackness, it may contain copper, lead, bismuth, or mercury, together with the metals first named. It is now to be treated with ammonia and sulphide of ammonium, which will dissolve the sulphides of arsenic, antimony, and tin. The ammoniacal solution may be poured upon the filter (stirring the precipitate meanwhile with a feather or with a glass rod covered with caoutchoue) until all soluble matter is removed. The precipitate is then to be washed, and the first filtrate, mixed with the washings, is to be evaporated to dryness at a moderate temperature. The dry residue is to be treated with fuming nitric acid, and gently evaporated. This operation is to be repeated until the residue, while moist, is of a clear yellow colour. A few drops of water are to be added, and gradually a solution of carbonate of soda to neutralise the acid. A mixture of two parts of nitrate of soda and one part of carbonate of soda is then added, the whole is carefully mixed together and dried, then placed in a porcelain crucible, and gradually heated to fusion. By this operation all organic matter has been destroyed, and the metals present oxidised; the antimony is converted into antimoniate of soda, the tin into binoxide of tin, and the arsenic into arseniate of soda; the latter only is soluble in cold water. The fused mass, when cold, is therefore treated with cold water, and the solution placed in a porcelain dish; sulphuric acid is then added until the liquid is strongly acid. This expels any nitric and nitrous acids that may be present; it is then evaporated, and, when quite concentrated, more sulphuric acid is added. If no red fumes appear upon the last addition, it has been added in sufficient quantity; if they are produced, the operation must be repeated. The solution, finally, must be evaporated until the white fumes of sulphuric acid are given off. Any arsenic present is now in solution as arsenic acid. It is desirable, in order to determine the weight of arsenic present, to convert it into arsenious acid; this is readily done by adding concentrated sulphurous acid solution until its odour is distinctly perceptible, then evaporating the liquid until its odour disappears.

(To be continued.)

On a Method of Preparing Certain Pharmaceutical Extracts, by M. Pierlot.

M. Pierlot's process is especially valuable in preparing extracts of aromatic plants, their useful principles being necessarily dissipated during the preparation of extracts by the ordinary method. It might pass for an ingenious application of M. Millon's researches on the subject of vegetable perfumes if the author, who does not quote M. Millon, did not appear to be unaware of his work.

Into a displacement apparatus, a fresh plant, such as absinthe, tansy, milfoil, camomile, primrose root, valerian root, &c., is introduced, and covered with ether, which gradually expels the water of vegetation, and retains the volatile aromatic principles of the plant. The displaced water occupies the lower part of the funnel, holding in solution the extractive matter, the albumen, and several saline principles. In proportion as it is drawn off, the water is replaced by fresh quantities of ether, and as soon as the ether ceases to displace water the plant is put under the press, and treated again by ether.

The different quantities of ether which have been used are now to be mixed, and distilled in a water bath at 30°. This distillation produces ether, with hardly any impregnation, and a residuary (formed of an essential oil, of a bluish colour, and a greenish-yellow, resinous, fatty matter) containing all the perfume of the plant.

The displaced water contains the extractive matter and the albumen. By shaking up with a little alcoholised ether, the coagulated albumen rises to the surface, and is separated by filtration. The extractive matter is obtained by evaporation.

The union of these two residuums gives an odorous extract, representing very exactly all the active elements of the plant. Pharmaceutists who attach an exaggerated amount of importance to the appearance of their medicaments can object to it only on account of its forming with water-troubled solutions.

M. Pierlot says that all the fresh flowers and roots he has treated in this way have yielded almost identical quantities of extract,—about ten per cent., two parts of aromatic principles, and eight parts of extractive. He adds:—"It is useless to enlarge on the therapeutical and pharmaceutical advantages of this method of preparing extracts of aromatic plants. I will only remark that, from a pharmaceutical point of view, the process forms the commencement of analysis,—that is to say, the estimation of these medicaments. The word 'commencement' is a necessary correction; for now-a-days it is not sufficient in analysing a plant to determine the amount of extract it will yield."—*Bulletin de Thérapeutique*, vol. lxi. p. 409.

Note on Green Pickles.

Into the preparation of pickled vegetables, remarkable for the intensity of their green colour, a preparation of copper, often in large proportions, almost always enters either directly or indirectly. This practice having been very justly condemned, attempts have been made to obtain the same colour with innocuous agents. Nothing succeeds better than boiling the vegetables in water made slightly alkaline sometimes either with a small quantity of bicarbonate of soda, sometimes with lime-water, and sometimes with saccharate of lime or with water containing a quarter of an ounce of liquid ammonia to the quart.

On the Leaves and Flowers used in Pharmacy, by M. E. Filhol.

In the course of my researches on vegetable colouring matters, I have often had occasion to observe a fact well known among pharmaceutists, namely, the decoloration of leaves and flowers under the influence of light, air, and humidity.

It seemed to me necessary to ascertain whether the colouring matter only disappeared, or whether some of the medicinal principles did not go with it.

Several analyses of this kind have already been attempted, but as yet we have no complete work on this subject. The following considerations show that it is very desirable this question should be seriously studied.

The numerous experiments I have for several years been making prove that, besides chlorophyl, leaves contain quercitrin or quercetine, and sometimes both these matters. Sometimes, also, we find small quantities of the yellow colouring matter of flowers known as xanthine.

Red, rose, and blue flowers are coloured by cyanine. Yellow flowers owe colour to xanthine, xantheine, or to croco-xanthine.

In fact, almost all flowers, like leaves, contain either quercitrin or quercetine; moreover, they all contain notable quantities of sugar. In estimating the quantity of quercitrin, if we compare leaves carefully dried and preserved from contact with the air, light, and moisture, with leaves of the same kind badly preserved, such as are often sold by druggists, these we shall find contain much less quercitrin than the well preserved leaves. Instead of a crystallisable and well defined compound, we obtain from the badly dried leaves nothing but apparently extractive matters, resulting from the alteration of the proximate principles originally contained in the plant.

It is the same with flowers.

It can, moreover, be shown that flowers lose their sugar with their colour. It is readily understood that the principal odorants also disappear.

By isolating the above-mentioned vegetable colouring matters it is easily proved that these matters when pure alter very slowly by contact with air, water, and light; but it is altogether the reverse when they are associated, as in leaves and flowers, with a vegetable tissue. Then they rapidly disappear. In such a case it might be said that the vegetable tissue acts like spongy platinum, and facilitates the combination of the elements of the air or water with the proximate principles contained in the plants.

To me this fact seems of the greatest importance, for though the proximate principles, which if pure may be preserved indefinitely, undergo alteration when associated with vegetable tissues, there is nothing to show that the substances which appear to possess great stability are not destroyed in a short time under the influence of light, air, and moisture when associated with vegetable cells.

It would be very serviceable to ascertain whether alkaloids, vegetable acids, &c., do not disappear as well as sugar and colouring matters when the plants which should contain them are altered. We know already that digitalis leaves when they have been badly dried contain less digitaline. It is probable that the leaves of belladonna, stramonium, night-shade, &c., after being decolorised under the above-mentioned influences, contain a smaller proportion of alkaloid than leaves carefully gathered, dried, and preserved.

Most of the druggists in the South of France seem to forget that these plants, being the principal ingredients of powders, tisans, extracts, syrups, dyes, &c., the activity of all these preparations is lessened or destroyed if the plants themselves are not properly preserved.

In publishing this short paper, my object has chiefly been to show that, when leaves or flowers lose their colour, with it they lose principles which it is necessary to preserve.—*Compte-Rendu de la Societé d'Emulation des Pharmaciens de la Haute-Garonne.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, July 20, 1862.

The Duke of Northumberland, *K.G., F.R.S. President, in the Chair.*

M. Faraday, *Esq, D.C.L., LL.D., F.R.S., Fullerian Professor of Chemistry, R.I.,* "*On Gas Furnaces, &c.*"

The subject of the evening was gas-glass furnaces, and having arisen almost extemporaneously, it resolved itself chiefly into an account of the manner in which Mr. Siemens has largely and practically applied gas, combined with the use of his heat regenerator, to the ignition of all kinds of great furnaces. Gas has been used to supply heat, even upon a very large scale, in some of the iron blast furnaces, and heat which has done work once has been carried back in part to the place from whence it came to repeat its service; but Mr. Siemens has combined these two points, and successfully applied them in a great variety of cases—as the potter's kiln—the enameller's furnace—the zinc-distilling furnace—the tube-welding furnace—the metal-melting furnace—the iron-puddling furnace—and the glass furnace, either for covered or open pots—so as to obtain the highest heat required over any extent of space, with great facility of management, and with great economy (one-half) of fuel. The glass furnace described had an area of twenty-eight feet long and fourteen feet wide, and

contained eight open pots each holding nearly two tons of material.

The gaseous fuel is obtained by the mutual action of coal, air, and water at a moderate red heat. A brick chamber, perhaps six feet by twelve, and about ten feet high, has one of its end walls converted into a fire-grate, *i.e.*, about half-way down it is a solid plate, and for the rest of the distance consists of strong horizontal plate bars, where air enters; the whole being at an inclination such as that which the side of a heap of coals would naturally take. Coals are poured, through openings above, upon this combination of wall and grate, and being fired at the under-surface, they burn at the place where the air enters; but as the layer of coal is from 2 to 3 feet thick, various operations go on in those parts of the fuel which cannot burn for want of air. Thus the upper and cooler part of the coal produces a larger body of hydrocarbons; the cinders or coke which are not volatilized approach, in descending, towards the grate; that part which is nearest the grate burns with the entering air into carbonic acid, and the heat evolved ignites the mass above it; the carbonic acid, passing slowly through the ignited carbon, becomes converted into carbonic oxide, and mingles in the upper part of the chamber (or gas-producer) with the former hydrocarbons. The water, which is purposely introduced at the bottom of the arrangement, is first vaporised by the heat, and then decomposed by the ignited fuel and rearranged as hydrogen and carbonic oxide; and only the ashes of the coal are removed as solid matter from the chamber at the bottom of the fire-bars.

These mixed gases form the gaseous fuel. The nitrogen which entered with the air at the grate is mingled with them, constituting about a third of the whole volume. The gas rises up a large vertical tube for 12 or 15 feet, after which it proceeds horizontally for any required distance, and then descends to the heat-regenerator, through which it passes before it enters the furnaces. A regenerator is a chamber packed with fire-bricks, separated so as to allow the free passage of air or gas between them. There are four placed under a furnace. The gas ascends through one of these chambers, whilst air ascends through the neighbouring chamber, and both are conducted through passage outlets at one end of the furnace, where mingling they burn, producing the heat due to their chemical action. Passing onwards to the other end of the furnace, they (*i.e.* the combined gases) find precisely similar outlets down which they pass; and traversing the two remaining regenerators from above downwards, heat them intensely, especially the upper part, and so travel on in their cooled state to the shaft or chimney. Now, the passages between the four regenerators and the gas and air are supplied with valves and deflecting plates, some of which are like four way-cocks in their action; so that by the use of a lever these regenerators and air-ways, which were carrying off the expended fuel, can in a moment be used for conducting air and gas into the furnace; and those which just before had served to carry air and gas into the furnace now take the burnt fuel away to the stack. It is to be observed, that the intensely heated flame which leaves the furnace for the stack always proceeds downwards through the regenerators, so that the upper part of them is most intensely ignited, keeping back, as it does, the intense heat: and so effectual are they in this action, that the gas which enters the stack to be cast into the air is not usually above 300° F. of heat. On the other hand, the entering gas and air always passes upwards through the regenerator, so that they attain a temperature equal to white heat before they meet in the furnace, and there add to the carried heat that due to their mutual chemical action. It is considered that when the furnace is in full order, the heat carried forward to be evolved by the chemical action of combustion is about 4000°, whilst that carried back by the regenerators is about 3000°, making an intensity of power which, unless moderated on purpose, would fuse furnace and all exposed to its action.

Thus the regeneratora are alternately heated and cooled by the outgoing and entering gas and air, and the time for the alternation is from half an hour to an hour, as observation may indicate. The motive power on the gas is of two kinds—a slight excess of pressure within is kept up from the gas producer to the bottom of the regenerator to prevent air entering and mingling with the fuel before it is burnt; but from the furnace, downwards through the regenerators, the advance of the heated medium is governed mainly by the draught in the tall stack, or chimney.

Great facility is afforded in the management of these furnaces. If, whilst glass is in the course of manufacture, an intense heat is required, an abundant supply of gas and air is given; when the glass is made, and the condition has to be reduced to working temperature, the quantity of fuel and air is reduced. If the combustion in the furnace is required to be gradual from end to end, the inlets of air and gas are placed more or less apart the one from the other. The gas is lighter than the air; and if a rapid evolution of heat is required as in a short puddling furnace, the mouth of the gas inlet is placed below that of the air inlet; if the reverse is required, as in the long tube-welding furnace, the contrary arrangement is used. Sometimes, as in the enameller's furnace, which is a long muffle, it is requisite that the heat be greater at the door end of the muffle and furnace, because the goods, being put in and taken out at the same end, those which enter last and are withdrawn first, remain, of course, for a shorter time in the heat at that end; and though the fuel and air enters first at one end and then at the other, alternately, still the necessary difference of temperature is preserved by the adjustment of the apertures at those ends.

Not merely can the supply of gas and air to the furnace be governed by valves in the passages, but the very manufacture of the gas fuel itself can be diminished, or even stopped, by cutting off the supply of air to the grate of the gas producer; and this is important, inasmuch as there is no gasometer to receive and preserve the aëriform fuel, for it proceeds at once to the furnaces.

Some of the furnaces have their contents open to the fuel and combustion, as in the puddling and metal-melting arrangements; others are enclosed, as in the muffle furnaces and the flint-glass furnaces. Because of the great cleanliness of the fuel, some of the glass furnaces, which before had closed pots, now have them open, with great advantage to the working and no detriment to the colour

The economy in the fuel is esteemed practically as one-half, even when the same kind of coal is used either directly for the furnace or for the gas producer; but, as in the latter case, the most worthless kind can be employed —such as slack, &c., which can be converted into a clean gaseous fuel at a distance from the place of the furnace, so many advantages seem to present themselves in this part of the arrangement.

It will be seen that the system depends, in a great measure, upon the intermediate production of carbonic oxide from coal, instead of the direct production of carbonic acid. Now, carbonic oxide is poisonous, and, indeed, both these gases are very deleterious. Carbonic acid must at last go into the atmosphere; but the carbonic oxide ceases to exist at the furnace, its time is short, and whilst existing it is confined on its way from the gas producer to the furnace, where it becomes carbonic acid. No signs of harm from it have occurred, although its application has been made in thirty furnaces or more.

The following are some numbers that were used to convey general impressions to the audience. Carbon burnt perfectly into carbonic acid in a gas producer would evolve about 4000° of heat; but, if burnt into carbonic oxide, it would evolve only 1200°. The carbonic oxide, in its fuel form, carries on with it the 2800° in chemical force, which

it evolves when burning in the real furnace with a sufficient supply of air. The remaining 1200° are employed in the gas producer in distilling hydrocarbons, decomposing water, &c. The whole mixed gaseous fuel can evolve about 4000° in the furnace, to which the regenerator can return about 3000° more.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

1874. George Peterson, Brompton Square, London, "Improvements in apparatus for ascertaining the quantity and strength of spirits or other products obtained by the process of distillation."—A communication from Theodor Steinberg, Oseenovoy Koost. near Saratof, Russia.

985. George Haseltine, Fleet Street, London, "Improvements in lamps especially designed for burning hydrocarbon oils."—A communication from Anson Platt, M.D., and General William Rosecrans, Cincinnati, Ohio, U.S.

1252. William Clark, Chancery Lane, London, "An improved method of preserving animal and vegetable substances."—A communication from Mr. Jules Réné Lion, Boulevart St. Martin, Paris.

1263. Michael Henry, Fleet Street, London, "Improvements in apparatus for aërating liquids, and in fastenings for the said apparatus and for other articles."—A communication from Etienne Sébastien François, Boulevart St. Martin, Paris.—Petitions recorded April 29, 1862.

1338. Pierre Leon Auguste Theophile Sourbe, Comdon, France, "An improved method of maturing spirits and wines."—Petitions recorded May 5, 1862.

1440. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the purification of colza, rape, and other oils."—A communication from Charles Henri Michaud, Paris.

Notices to Proceed.

524. John Cliff, Imperial Potteries, Lambeth, Surrey, "Improvements in glazing stone-ware, red clay-ware, porcelain, and other kinds of earthenware."

525. William Miller, Upper Stamford Street, Blackfriars, Surrey, "Improvements in the manufacture of sugar."

532. George Torr, Buck's Row, Whitechapel, London, "Improvements in, and improved apparatus for, manufacturing and reburning charcoal."

601. Edward Partington, Heap Bridge, Lancaster, "Certain improvements in the method of cleansing and preparing rags or other materials used in the manufacture of paper, and in machinery or apparatus connected therewith."—Petitions recorded March 5, 1862.

643. William John Bennett, Millbank Street, Westminster, "An improved solution or preparation to be used with Portland and other cements for the production of artificial stone, or for building purposes."

645. William Samuel Nosworthy, Coleman Street, London, "Improvements in upright and horizontal pianofortes."

830. Leo de La Peyrouse, Panton Square, London, "Improvements in the preservation of animal substances."—Petition recorded March 26, 1862.

262. Pierre Scheurweghs and Alexandre Joseph Aurele Henry de Boisserolle, Paris, "Certain improvements in treating fatty and oily matters for obtaining their acidification, and in the apparatus employed therein."—Petitions recorded January 31, 1862.

320. John Tonkin, jun., Pool, Illogan, Cornwall, "Improvements in the manufacture of gunpowder."—Petitions recorded February 6, 1862.

349. William Clark, Chancery Lane London, "Improvements in refining cast iron, wrought, and other malleable iron, and in the cementation of iron."—A communication from Louis Joseph Frédéric Margueritte and Alfred Lalouel de Sourdeval, Boulevart St. Martin, Paris.—Petition recorded February 10, 1862.

1455. Henry Deacon, Appleton House, Appleton, Lancashire, "Improvements in the manufacture and production of certain colours, and in the apparatus employed therein."—Petition recorded May 14, 1862.

139. Thomas Roberts and John Dale, Manchester, "Improvements in the manufacture of gunpowder."—Petitions recorded January 18, 1862.

154. John Bate, Crescent, Birmingham, "Improvements in machines for corking or stopping the mouths of bottles, jars, or any vessel requiring to be stopped up air-tight."

209. William Orr, Greenock, Renfrewshire, N.B., "Improvements in machinery or apparatus for the manufacture of sugar."—Petitions recorded January 27, 1862.

Invention Protected for Six Months by the Deposit of a Complete Specification.

1505. Edmund John Bridell, Middle Temple, London, "Improvements in the manufacture of substances artificially coloured, veined, or mottled, like marbles or other substances."—Deposited and recorded May 17, 1862.

CORRESPONDENCE.

The Preservation of Stone.

To the Editor of the Chemical News.

Sir,—The preservation of stone being a very important object, I have transcribed some observations and experiments upon this subject from a paper by Mr. Edward King, in the *Philosophical Transactions* for 1779, which would, I think, be interesting to some of the readers of the Chemical News, and the reproduction of which may be of utility. The paper is entitled, "Account of a Petrifaction on the coast of East Lothian."

It may be found (p. 44) that he received the following information from Dr. Fothergill. On passing through the streets of London in his walks, before the sign-irons were taken down, he perceived that on the broad stone pavements, whenever he came just under any sign-irons, his cane gave a different sound, and occasioned a different kind of resistance to the hand, from what it did elsewhere; and attending more particularly to this circumstance, he found that everywhere under the drip of those irons the stones had acquired a greater degree of solidity, and a wonderful hardness, so as to resist any ordinary tool, and gave, when struck upon, a metallic sound; and this fact, by repeated observations, he was at length most thoroughly convinced of. Taking the hint, therefore, from hence, he thought fit to make several experiments; and, amongst the rest, placed two pieces of Portland stone in the same aspect and situation in every respect, but washed the one frequently with water impregnated with rusty iron, and left the other untouched: and in a very few years he found the former had acquired a sensible degree of that hardness before described, and on being struck gave the metallic sound; whilst the other remained in its original state, and subject to decays occasioned by the changes of the weather, which we find in many instances make a most rapid progress.

The following hints, also, were received from Dr. Fothergill. If iron and the solutions of iron do thus contribute to the induration of bodies, such solutions must probably have that tendency in every stage of those bodies' existence; and therefore it seems likely that the fine ornamental carvings in Portland or other stone might be much hardened, and preserved for a much longer time than has been usual from the injuries of the weather, by being washed and brushed over by water in which is infused a solution of iron. And perhaps even the softer kinds of stones might have been preserved by this means, and the venerable remains of that fine pile of building, Henry the

Seventh's Chapel, might have been saved from the destruction with which we now see it ready to be overwhelmed. It is very probable, moreover, that common sea sand, with a very small admixture of a solution of iron, may at length, without any great expense, be converted into a most useful species of stone, and be applied to the purpose of covering the fronts of houses even more durably, and in as beautiful a manner as some of the late invented stuccoes; and even those stuccoes may be improved by means of the same mixture.

It must, of course, be concluded, from these remarks, that the application of iron for the purpose of preserving stone is not very recent, and also that, thus early, the idea of artificial stone was entertained. I believe that some salt of iron has been proposed as a means of preserving the stone of the Houses of Parliament, and would direct attention to the simple experiment here described, which, if not approved of, may be the occasion of some other plan being suggested. I would also say that an account of it was by me, some months ago, sent to a scientific journal, but that it was not published.—I am, &c.

J. Alexander Davies.

July 19.

On the Detection of Strychnia.

To the Editor of the Chemical News.

Sir,—In continuing my communications upon this subject, I am far from wishing to introduce anything of a personal nature; the only interest I have at heart is the advancement of science. Harvey, Galileo, and a host of other eminent men in bygone ages have been discredited, and evil spoken of, because what they advanced was not at first sufficiently understood and appreciated, so that I cannot expect to be singular. Thus much I will say from a thorough knowledge of the value of this method of detecting strychnia, compared with those ordinarily practised. I am prepared to meet with any amount of obloquy attempted to be cast upon me. I have not weighed this matter lightly, as you may suppose, or I should not have appeared so often in print. Strange as it may appear, we have yet something to learn from it. I may, perhaps, have been somewhat in fault at first in attributing such and such effects as due solely to nitro-prusside of sodium in the compound I used, as has already been stated in my communication contained in the last number of the Chemical News, that the washed precipitate from using pure nitro-prusside does not, as Mr. Rodgers also states (and I have proved the same with some obtained from London), produce the characteristic purple and violet colour with sulphuric acid, unless accompanied with a small amount of peroxide of manganese; but with an extemporaneous preparation, as I offered to furnish any gentleman with, I can readily detect $\frac{1}{100000}$ of a grain of strychnia, as witnessed by a scientific chemist from some of the first laboratories in London, the which has also been confirmed by other eminent men. This degree of sensibility is far beyond what has ever been obtained before by the ordinary processes. What there is in my compound which is so extraordinary, I am at present not prepared to say; but it is a fact. It is certainly not due to ferricyanide, as experiments with 10 drops of a thousand-grain mixture, containing $\frac{1}{100}$ grain of strychnia, and 5 drops of that reagent = 10,000 of a grain, did not satisfactorily give the usual purple colour, and was perfectly useless beside mine of the $\frac{1}{100000}$.

I shall be happy to send any gentleman who is really interested in the matter, a sample of my dried extemporaneous compound, described in the *Medical Times and Gazette* of July 12, for experiment, when they will find what I say is true,—that it will detect so small a quantity of strychnia with the greatest ease. That nitro-prusside is present, is shown by the application of a sulphide, and that ferricyanide likewise exists in tolerable quantity is also proved by sulphate of iron; but that the delicacy of the reaction is not altogether dependent on them is evident; something else is involved in it, but what it is has not yet been determined.

Much has been said of the delicacy of sulphuric acid and manganese, I therefore beg to subjoin the following by way of comparison:—

Mr. Horsley's compound . .	equal to	$\frac{1}{100000}$
Sulphuric acid and manganese .	,,	$\frac{1}{10000}$
Bichromate of potash .	,,	$\frac{1}{3000}$

The first is, therefore, ten times more delicate than the second, and thirty times more than the third.

I forgot to add that Mr. Rodgers twits me in reference to having said I dissolved one grain of strychnia in 100 grains of water. Now that is paltry in the extreme. Of course acidulated water or an acid salt was implied.

I am, &c.

John Horsley, F.C.S.

Cheltenham.

MISCELLANEOUS.

A New Use for Carbolic Acid.—J. E. Ashby, LL.D., writes from Enfield to the *Mechanics' Magazine* as follows:—"Most persons have by this time heard that there is such a substance as carbolic acid; comparatively few have seen it, fewer still have used it, and no one (so far as I can find) has yet noticed a very remarkable property which it possesses in relation to practical mechanics. For the information of those to whom the substance itself is unknown, a word or two will be sufficient to introduce it to their notice. Carbolic acid is one of the products of the destructive distillation of coal, and till within a few years vast quantities of it were utterly wasted. When perfectly pure it is a white crystalline solid, which by absorbing water soon changes into a colourless refractive liquid, having a faint odour of roses and tar. It is not an acid in the popular sense, not being either sour or corrosive, and should therefore, perhaps, be generally designated by its other title of phenole. Crude carbolic acid may be obtained in bulk for about a shilling per gallon, and is a dark tarry liquid, containing, perhaps, from ten to twenty different substances, in a state of mechanical admixture. Fortunately, this crude acid is available for the purposes to which I invite the attention of your readers. Just as oil is an anti-frictional liquid, so is phenole pro-frictional; or, to state it more correctly, as oil appears to keep surfaces in motion asunder by interposing a thin film between them, so phenole appears to make them bite and bind, by bringing them into absolute contact (after a manner of speaking), and removing even the finest film from between them. Any one may convince himself of this by placing a little upon a perfectly clean and dry oil-stone, and then rubbing up the face of a broad chisel upon it. The sensation of the bite (I know of no other word to express it) is very curious, and renders any further explanation unnecessary; it seems as if the stone and the steel had absolutely nothing between them, or even as if they were positively brought together by some attractive force. I have applied this property of carbolic acid to the following operations:—grinding, filing, boring, and sawing in metal, with great apparent advantage. When dissolved in fifteen parts by measure of methylated alcohol, it forms a milk-white emulsion if poured into water, and it may be worth while to ascertain whether such carbolated water would facilitate the ordinary work of the grindstone, a point on which I am not able to speak with certainty. If any of your readers should experience, as I did, much difficulty in obtaining the crude carbolic acid, I shall have much pleasure in indicating the source whence mine was derived, or in supplying any practical engineer with a small sample so long as my little quantity holds out."

THE CHEMICAL NEWS.

VOL. VI. No. 139.—August 2, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Preparation of Permanganic Acid, by M. A. TERREIL.

THE chemist Chevillot first stated that when permanganate of potash is mixed with sulphuric acid and heated to 130° C., violet vapours are obtained, condensible into an oily red liquid, consisting, according to this chemist, of sulphuric acid and permanganic acid.*

More recently, M. H. Aschoff has prepared permanganic acid in the same way, but only collecting the small drops forming in the mixture of permanganate of potash with concentrated sulphuric acid.†

I now propose to give some new facts about the preparation of permanganic acid, and to describe some new properties of this acid.

Permanganic acid is obtained by dissolving permanganate of potash in pure sulphuric acid, diluted with about half an equivalent of water, taking care that the temperature does not get too high. The solution is a yellowish green. Introduce it into a tubulated retort communicating with a well cooled receiver. In this apparatus neither corks nor other organic matter must be used.

The retort is placed in a water bath and heated to a temperature not exceeding 60° or 70°; at a higher temperature sulphuric acid passes over. The apparatus then becomes filled with violet vapours, resembling those of iodine. The vapours soon condense in the neck of the retort to a thick liquid of a greenish-black colour, which contains neither sulphuric acid nor chlorine. This is permanganic acid.

It is difficult to prepare a large quantity of this acid at once. It always, at a certain time, when the proportion of distilled acid commences to be considerable, decomposes spontaneously with a slight detonation. After this decomposition a solid body is found in the apparatus of a brownish-black colour and extreme lightness, possessing the properties of sesquioxide of manganese.

If the sulphuric acid solution of permanganate of potash is exposed to moist air for some time, or better, if a few drops of water are added to it, the permanganic acid will be seen to float upon the surface of the liquid in the form of oily drops of a greenish-black metallic lustre, which sometimes solidify and fall to the bottom of the liquid. It is difficult to separate this acid from the sulphuric acid which contaminates it; but in this state the permanganic acid may be used for the oxidation experiments described below.

Permanganic acid is a thick liquid, of a greenish-black colour and metallic appearance. It seems to be capable of solidifying. It is very greedy of water. Its solution is violet, and it keeps pretty well when dilute and free from dust.

If permanganate of potash is suddenly heated it detonates; but if moderately heated, part volatilises, producing violet vapours, which possess a very disagreeable metallic odour.

This compound is perhaps the most energetic oxidising agent known. It instantly sets fire to paper and alcohol, the latter with explosion. In these combustions there are always produced violet vapours, due to the volatilisation of a certain quantity of permanganic acid. It detonates suddenly, with emission of a beautiful white light when placed in contact with a fatty body. In this case very little acid must be used, for the detonation is very strong.

If a few drops of a solution of sulphite of potash is poured upon permanganic acid a very lively reaction is produced with disengagement of light. A large quantity of acid is carried off in the form of violet vapours, which are reduced in the air, and fall down in the form of brown flocks, very light, similar to oxide of zinc when this metal is burned in contact with air.

This curious reaction will doubtless become a beautiful lecture experiment. It succeeds very well with the permanganic acid formed in the sulphuric solution of permanganate of potash.

Permanganic acid is slightly soluble in concentrated sulphuric acid; the solution is green. Its solution in sulphuric acid containing three equivalents of water is violet. This change of colour seems to point out that there exist an anhydrous permanganic acid and a hydrated acid.

The instability of permanganic acid has hitherto prevented me from determining its composition.—*Bulletin de la Société Chimique de Paris.*

* *Chimie de Berzelius*, vol. ii. p. 727.
Repertoire de Chimie pure et Appliquee, 1861, p. 178.

On the Composition of Aniline Reds, by M. E. KOPP

M. HOFMANN'S remarkable work, precise, perspicacious and original, like all the researches of this chemist, has completely modified all the opinions before admitted on the nature of aniline reds.

Before the publication of M. Hofmann's memoir, too much attention was given to the analogies which were supposed to exist necessarily between the colouring matter of carthame and aniline red: all phenomena were interpreted with a view to these analogies.

Carthamine acts as a colouring matter only when free and disengaged from all combination. As a hydrate, it has a beautiful red-carmine colour; dry, it presents the metallic reflections of cantharides or murexide.

Though not, strictly speaking, an acid, it will combine with alkalies. These combinations, soluble in water, are colourless, and carthamates possess no dyeing quality. To make this tinctorial property reappear, it is sufficient

to saturate the alkali with an acid, and in this state at the moment of disengagement from its alkaline combination carthamine dyes most easily. Thus it was admitted that the pure free red, presenting when dry green metallic reflections, which constitutes the colouring matter, and which dissolved in pure water is again precipitated from it by the addition of neutral alkaline salts.

It has been established that aniline red acts principally as a base, and that it will combine with acids. But these combinations were considered unstable and decomposable by water alone, which, removing the acid, sets the red at liberty with all its tinctorial properties.

Thus was explained the decoloration of a cloth dyed with aniline red by printing it with an energetic acid such as hydrochloric, nitric acid, &c. Where the acid and red came in contact a combination took place, which, being almost colourless, produced white or yellowish tints. But on washing the cloth in plenty of water, the red or rose tint reappeared, because the water took away the acid, and with it, in fact, a certain quantity of red, yet leaving sufficient on the cloth to reproduce the characteristic rose colour.

On the other hand, it was generally admitted that aniline red would also combine with bases, forming colourless combinations (fuchsates) possessing no dyeing properties; but that the addition of an acid, however weak, would destroy this combination, setting the red at liberty with all its dyeing properties.

These views seemed to be corroborated by the phenomena presented by a cloth coloured by aniline red, a white spot forming immediately on the application of ammonia or any other alkali. But little by little, especially after the application of ammonia, the red colour reappears in proportion as the ammonia disengages itself. The reappearance of the colour was naturally attributed to the gradual decomposition of the fuchsate of ammonia,—a combination supposed to be so unstable as to lose its ammonia spontaneously in the air, leaving the aniline red free and coloured on the cloth.

Hofmann's researches have modified and rectified most of these explanations. They show, in fact:—

1. That what was considered as free aniline red, fuchsine, azaleine, Depouilly's red, &c., was in reality a salt of rosaniline, more or less pure, and capable of containing free rosaniline, for they are salts which dried have the green metallic appearance of cantharides' wings, and which, dissolved in water or alcohol yield the beautiful crimson colour which has made aniline reds so celebrated.

2. That there are more acid salts of rosaniline, which are precipitated from their watery solution when neutral alkaline salts are dissolved in it.

But from this fact flows the important inference that this precipitate may be accompanied by double decompositions. Thus, in dissolving in pure water acetate or nitrate of rosaniline, a coloured precipitate is obtained by dissolving chloride of sodium in the solution.

But this precipitate will not be pure acetate or nitrate of rosaniline. It will contain more or less rosanilic chloride, if this latter salt is less soluble than the acetate or nitrate.

This is, in fact, what takes place.

We have boiled MM. Lauth and Depouilly's pure red (obtained by precipitating the boiling solution of rough red prepared by nitric acid by means of sea salt) with a slight excess of milk of lime. The filtered liquid was perfectly colourless. It was evaporated in a water bath. (During evaporation rose-coloured circles were deposited on the sides of the capsule, yellowish flakes at the bottom of the liquid, which in two experiments took a beautiful azure colour.)

In the salt of lime forming the residuum from the evaporation the presence of notable quantities of hydrochloric acid was easily detectable.

It is now very easy to explain the results obtained by M. Bolley. In precipitating rough fuchsine (prepared by bichloride of tin and aniline) by means of sea salt, the precipitate contained chlorine, but no oxygen. In precipitating the same fuchsine by saltpetre, the precipitate contained both chlorine and oxygen.

By dissolving chlorated fuchsine in diluted sulphuric acid, heating for several hours, saturating with pure carbonate of soda, and precipitating by saltpetre, a precipitate is obtained containing no chlorine.

In the first case the precipitate consisted only of chloride of rosaniline. In the second, of a mixture of rosanilic chloride and nitrate. In the third, all the hydrochloric acid having been expelled by the sulphuric acid, the precipitate contained no chloride, but very probably a mixture of more or less pure rosanilic nitrate and sulphate, and perhaps (on account of the saturation by carbonate of soda) a certain proportion of free rosaniline.

3. By the action of energetic acids on aniline reds, triacid salts of rosaniline are formed, which, being yellow, effaces the coloration of the tissues. The triacid salts being unstable are decomposed by water, which withdraws two equivalents of acid and regenerates the monacid salt,—that is to say, the rose-red colouring matter.

Again, in this case the red salt may have been modified by the acid used to dissolve it, so that, for instance, the acetate of rosaniline having been dissolved in hydrochloric acid, the water precipitates rosanilic chloride from the solution. It will also be understood that by dissolving nitrate of rosaniline in hydrochloric acid by heat, part of the colouring matter may be destroyed by the formation of *aqua regia* and its action on rosaniline.

4. The most remarkable and important fact established by M. Hofmann is, that in making alkalies react on aniline reds, the disappearance of colour was due not to the combination of the alkalies with the red, but to the setting at liberty the base, which when pure is colourless.

The restoration of colour by acids is caused by the reconstitution of the salts of rosaniline.

We are of opinion that this extraordinary property of rosaniline (scarcely another instance of which is known), of being colourless when first set at liberty, but gradually taking a rose tint, then deepening to reddish-rose, and finally to carmine-red, when exposed to the air, —and all this without undergoing alteration either in weight or composition,—is worthy of deep study.

To this phenomenon other phenomena are connected, the causes of which ought to be investigated. We will give an instance:—

Having dissolved some of Lauth and Depouilly's pure red in weak, tepid hydrochloric acid, we gradually poured it into a slight excess of boiling milk of lime. After ten minutes boiling the precipitate was nearly white, and the supernatant solution quite colourless. Thinking to dissolve the slight excess of lime, we added chloride of ammonium to the boiling solution, to form chloride of calcium and free ammonia, which was disengaged by boiling. At the moment the ammoniacal chloride was added, the white precipitate became dark rose-colour, the liquid remaining colourless.

Though Mr. Hofmann's admirable memoir has thrown great light on the history of aniline reds, and has explained away the errors previously published, many questions remain as yet unresolved.

It is perfectly intelligible that, having considered fuchsine, Depouilly's pure red, &c., as free colouring matters, we may regard fuchsine (chloride of rosaniline) as a chlorated body, and the nitrate as a nitrated compound.

To facilitate the comparison of previous analyses with M. Hofmann's, we will give the centesimal composition of the hydrate, chloride and nitrate of rosaniline, and, among others, of nitrated rosaniline, a body as yet hypothetical:—

$$C_{40}H_{18}[NO_4]N_3 = C_{40}H_{18}N_4O_4.$$

		C.	H.	N.	O.	Cl.
Hydrated rosaniline,	$C_{40}H_{21}N_3O_2$	75·23	6·58	13·16	5·03	—
Rosanilic chloride,	$C_{40}H_{20}N_3Cl$	71·11	5·92	12·44	—	10.53
Rosanilic nitrate,	$C_{40}H_{20}N_4O_6$	65·93	5·49	15·38	13·20	—
Nitrated rosaniline,	$C_{40}H_{18}N_4O_4$	69·35	5·20	16·18	9·26	—
Nitrated leucaniline,	$C_{40}H_{20}N_4O_4$	68·96	5·75	16·09	9·20	—

M. Hofmann having experimented with the products of M. Nicholson, who, in January, 1860, took out a provisional patent for the preparation of aniline red by arsenic acid, it is very probable that it is this red purified by a new process not yet made public, which has served as a base for the brilliant memoir of the celebrated English chemist.

Though it can hardly be doubted that the other methods of preparing aniline red equally produce salts of rosaniline, it is nevertheless desirable that this should be proved experimentally. It would also be useful to know whether nitrated rosaniline is not formed by the action of nitric acid upon aniline.

We likewise think it best to advert to the absence, in M. Hofmann's memoir, of any description of nitrate of rosaniline and its properties.

It would be very interesting to know the nature of the easy transformation of acid salts of rosaniline into a particular aniline violet, under the influence of rough wood-spirit or aldehydes.

The examination and solution of all these questions is rendered much more desirable by the publication of M. Jaquelain's "Etude des Mattières Colorantes et Colorées, Extraites à l'état de pureté des Produits Commerciaux de l'Aniline" (*Comptes-Rendus*, vol. liv. March 17, 1862, p. 612), which tends to establish a difference between the pure products arising from the processes of preparation.

M. Jaquelain has obtained:—

By arsenic acid from rough red, a crystallised red and violet.

By nitric acid from rough red, a crystallised red and violet.

From rough red, an uncrystallised red and a crystallised violet by mercurial nitrate.

From rough red, a crystallised red and violet by bichloride of tin.

He thinks he is able to assert that aniline treated by nitric, arsenic, and sulphuric acids, by bichlorides of carbon and tin, and by mercurial nitrate, gives rise to three principal compounds,—namely, a red matter, a violet matter, and a resenoid matter of the colour of sepia, independently of the salts of aniline formed at the expense of the acids and even of the bases belonging to the agents employed, without prejudice to the coexistence of M. Hofmann's colourless bases, and that commercial products are mixtures in suitable proportions of these different bodies.

Physical and chemical characteristics, such as the solubility of these matters, appear to M. Jaquelain of a nature sufficiently decided to admit of his considering all these defined compounds as distinct, though having a certain analogy as colouring matters.

It is evidently essential to be certain that the differences observed between the crystallised reds obtained by M. Jaquelain are not caused by their being salts of different acids (arseniate, nitrate, chloride,) of the same base, which could hardly be anything but rosaniline and its derivatives.

The reactions and analysis of these compounds will easily decide this question.—*Répertoire de Chemie.*

TECHNICAL CHEMISTRY.

The Uses of the Indian Madar as a Substitute for Cotton.

Amongst the various proposed substitutes for cotton, there is one which has not as yet attracted the attention of scientific men,—the Indian madar plant. It is, nevertheless, admirably adapted for this purpose, as both the fibre, the floss, and juice can be employed for commercial purposes. In the year 1854 the prisoners of the Shahpore Native Gaol, Bengal, were employed in making mats and cloth from this plant, under the auspices of an officer who took great interest in the scientific resources of India.

The madar is a wild jungle plant, which grows to a considerable height, flourishing in almost any soil. Its leaves are ovate, very dark green, and very thick, somewhat resembling those of the laurel. The juice could be used instead of gutta-percha, over which it possesses a considerable advantage, as the madar plant retains its vitality after being repeatedly cut down to obtain the fluid. Moreover, the great abundance of the madar compared with the rareness of the gutta-percha tree would tend to augment the value of the madar juice. This fluid is at first milk-white, but changes, on exposure to the sun and air, to a dull brown, like india-rubber. It could be applied to every commercial use hitherto obtained from gutta-percha.

To proceed: as regards the use in which it could be substituted for cotton, if the stalks be soaked either in water or, still better, in weak alkaline lye, the fibres separate and can be carded like flax by the ordinary process. The natives simply separate the fibres with their teeth. These filaments are pale yellowish, like flax. They are very strong, as the natives of India use them for fishing-lines in place of catgut.

It had long been apparent to men of science how greatly it would conduce to the good of our cotton trade were we to have other emporia than the Southern States of America. We derive twofold advantage from growing cotton in our colonies and dependencies,—a cheaper supply, and a freedom from the uncertainty of relying on America for cotton. We do not even allude to the advantage of free over slave-labour in the cultivation of cotton. The fears of these men have been verified by the present American war. The supply of cotton from the Southern States has been entirely stopped, and many thousands of operatives, who

depended for their livelihood solely on the factories remaining open, have been reduced to extreme poverty and distress. Much of this, humanly speaking, might have been obviated had we grown cotton in British, not foreign, possessions.

Even supposing the application of the madar to be but partial, its cultivation, together with that of the cotton plant, might be carried on with great advantage. So far for the fibre. The floss of the madar strongly resembles unspun silk, being yellow coloured and very soft. It can be spun in a manner exactly similar to silk, to which it is scarcely inferior in quality. I have also a small portion of the cloth of the madar fibre made in the native gaol at Shahpore, Bengal Presidency. From it I am inclined to judge favourably of the probable quality of the cloth, if manufactured with greater care. Moreover, besides the cloth made from the fibre or the floss separately, a very useful fabric could be formed of both mixed, the woof being made of the floss. In this form, perhaps, the madar plant would be most useful, as the floss contributes softness, and the fibre strength and firmness. Were these remarks to excite the interest of any scientific men, I should be happy to enlarge on them with any further information in my possession, or to show specimens to any gentleman who might take an interest in the matter, or wish to investigate the subject more fully. H. H.

July 12.

On the Preservation of Meats, by M. Martin de Lignac.

In the usual way of salting, the meat is placed first in salt, and afterwards in pickle. The salt absorbs the liquids in proportion as they separate from the flesh, then the pickle penetrates by endosmose, and preserves them from any subsequent alteration by its antiseptic properties. But in this case the salt acts on the surface a long time before it penetrates to the centre, whence results an excess of salt at the surface, whilst the centre is not sufficiently salted, and still contains the principles of fermentation. To avoid this the habit is to cut up the meat; but this, while it increases the chances of its preservation, greatly alters its quality. In fact, the salt in contact with large surfaces absorbs too largely the liquids contained in the flesh, and extracts from them the aroma and a portion of their nutritive juices. Pork, the tissue of which is dense and protected by fat, bears this preparation better than beef, the flesh of which, after long standing in the salt, presents only a fibrous tissue without flavour, and with but a low nutritive power.

It results from these facts:—First, that meat preserved by the usual process contains necessarily too much salt, and that its prolonged use is injurious to health; secondly, that it loses a part—sometimes a notable part—of its nutritive value.

The method of avoiding these inconveniences is to salt uniformly and not subdivide too far the meat, thus preserving its aroma and its juices. I think that I have found the solution of this problem, and the following are the means which I employ:—

If it is a ham which I wish to salt, I introduce, by means of a trocar, between the bone and the muscle at the small end, a sound which I attach to a stop-cock, which communicates by a tube with a reservoir of water saturated with salt, to which are added various aromatics and condiments. The reservoir is from 25 to 35 feet high. When the stop-cock is opened, the liquid by its pressure rapidly separates the muscle, and the two or three ounces of pickle which are necessary for the preparation of one pound of meat are easily lodged in the cellular tissue which surrounds the bone. Thence it forms a kind of reservoir, the liquid spreads, penetrating all the fibres by infiltration, distributing regularly and homogeneously the conservative agent, and producing its first effect upon the part most susceptible of alteration, that which surrounds the bone. The hams thus prepared are put for some days in a pickle bath. The object of this bath is to prevent by its pressure the issue of the liquid injected, besides which it completes the preparation by saturating the surface. When they leave the bath the meat has lost nothing of the weight which it had at its entrance. I then expose them to a current of air at a moderate temperature. When by evaporation they have lost the infiltrated liquid and 5 per cent. of their normal weight, I expose them to the action of smoke for a time which varies with their weight. This latter operation is not necessary for their preservation, but it gives them a taste which is generally sought for, and effects a reduction of weight. On leaving the smoke-house they have lost from 12 to 15 per cent. of their weight; before entering they had already lost about 5 per cent., so that their whole loss is from 18 to 20 per cent.—*Cosmos.*

On the Manufacture of Damascus Swords.

In olden times the city of Damascus, in Syria, was renowned for its cutlery, and particularly for the manufacture of sword blades. The fame of these swords extended throughout Asia and most of Europe. They were so elastic that they could be bent like hoops, without breaking, while, at the same time, their cutting edge was as keen as that of a razor. Damascus blades possessed a wavy surface of regular bright and dark lines, and the mode of manufacturing them was kept a profound secret by the armourers of that city. Reese, in his "Cyclopædia," states that they were made of a peculiar kind of steel, and it was the character of the metal, not the mode of making them, which gave them such superiority. The same idea is conveyed in the interesting article on the subject in the "New American Cyclopædia." From information which we have received on the subject—and which we shall hereafter cite—such statements do not appear to be reliable. Reese says of Damascus swords:—"About the beginning of the fourteenth century, Timeur Leng, on his conquest of Syria, conveyed all the celebrated manufacturers of steel from Damascus to Persia. Since that period its works in steel are little memorable. They were formerly of the highest reputation in Europe and the East. The famous sabres appear to have been constructed by a method now lost, of alternate layers, about two or three times thick, of iron and steel. They never broke, though bent in the most violent manner, and they retained the utmost power of edge, so that common iron, and even steel, would divide under their force."

The method of manufacturing Damascus blades was, undoubtedly lost for centuries, but the "New American Cyclopædia" states that the Russian General, Anossoff, rediscovered the process of producing Damascus steel by smelting 11 lbs. of charcoal iron in a crucible with $\frac{1}{12}$th of graphite, $\frac{1}{32}$nd part of iron scales, and about $\frac{1}{24}$th of a fusible flux, such as dolomite. These substances are submitted to intense heat, in a blast furnace, for about

five hours, when the scoria is scummed off, and the molten ingot of steel thus formed is drawn under the hammer, and submitted to several heatings and hammerings. Of steel thus made, it is asserted that General Anossoff made several blades like those of Damascus, having the same dark and light wavy lines, which were produced after the blade was formed by pouring dilute sulphuric acid over it. General Anossoff died in 1851, and it is stated that his successors have not been able to produce such like swords. We do not wonder at this; for assuredly swords of the Damascus appearance, with wavy lines, cannot be made from bars of pure steel. The waving lines on such swords nearly resemble the minute and graceful shadings of the fine watered silk of which ladies' dresses are made, and they are due to the method of fabricating the blade, and also the combined metals of which it is composed. Blades resembling the old Damascus cimeters are not uncommon in this city, and they equal them in temper and elasticity. We are indebted to Mr. Herman Vasseur, No. 9, Maiden-lane, this city, sword mounter and scabbard manufacturer, for a description of these blades. They are made at Solingen, in Germany, the only establishment of the kind in the world. A faggot is first formed of alternate fine bars, or wires, of iron and steel. Such a faggot is then drawn out, doubled and twisted several times, and formed into a ribbon. Two of such forged ribbons of iron and steel are then welded together, enclosing a thin blade between them of the best cutting English steel, and thus a Solingen Damascus blade is formed. The interior thin blade of English steel gives the sword a desirable and perfect cutting edge, and the combined twisted iron and steel, outside layers, impart to it peculiar toughness, as well as the beautiful wavy surface, for which it is also much prized. When ground and polished, no wavy lines are recognised, but by dipping the blade for a short period into dilute sulphuric acid, a portion of the iron on the surface is dissolved, while the carbon of the fine steel bars is unaffected, and appears in dark wavy lines, contra-distinguished from the white wavy surfaces of the iron bars. These blades are imported plain, and mounted in this city. Mr. Vasseur has lately mounted some of them in a splendid manner, to order, as presentation swords for several officers of our army and navy. The scabbards are made wholly of silver, and highly ornamented, while the hilts are tastefully mounted, with appropriate designs, partly cast and partly engraved. A silver scabbard is made by hammering rolled plate silver upon an iron mandrel of the proper form, and thus the plain sheath is produced. The ornaments, consisting of neat designs in silver, are cast from patterns, then trimmed and soldered to the sheath. A considerable portion of these silver scabbards are also gilt. They are certainly splendid specimens of sword mounting.

The inlaying of iron and steel with gold and silver is called Damaskeening, because this art was carried on upon a great scale when Damascus was the armoury of Syria. It is executed by cutting burr grooves with a cold chisel in the steel before it is hardened, and then hammering gold or silver wire in these grooves. This art is of great antiquity. We have read and heard it frequently stated that the superiority of Damascus swords was due to the mode of tempering them. This consisted in heating the hardened blade to a blue colour, and handing it to a rider sitting on horseback, who instantly started off at a gallop, waving the blade against the cold north wind, which was required to be blowing at the time, or the operation could not be performed. We put no credence in such stories, because it is scarcely possible to temper a piece of very thin steel by waving it in the atmosphere, at a high velocity, during the coldest days in winter. The beauty and superiority of the Solingen blades must be credited chiefly to the skill of the artisans who fabricate them.—*Scientific American.*

PHARMACY, TOXICOLOGY, &c.

Medico-Legal Contributions on Arsenic, by Charles H. Porter, *M.D.,* Professor of Chemistry and Medical Jurisprudence, Albany Medical College.*

(*Continued from page 52.*)

III. *Method for Determining the Weight of Arsenic, and Making the Characteristic Tests.*

1. Determination of the Weight of Arsenic.—The solution obtained as just directed is to be diluted with water, placed in a beaker, together with the washings of the porcelain dish, and a stream of washed sulphydric acid passed into it. If any arsenic is present, it will be precipitated in the form of tersulphide of arsenic.

This is to be collected on a small filter (previously dried at 212° F. and weighed), then thoroughly washed, and dried at the same temperature as before, and again weighed. The increase in the weight of the filter represents the amount of tersulphide of arsenic present.

Or the precipitate may be collected on a small filter thoroughly washed, then dilute ammonia added drop by drop, until it is all dissolved; the filtrate and the washings are to be collected in a weighed dish, and evaporated to dryness and weighed as above.

Each part of persulphide of arsenic is equal to 0·8049 of arsenious acid, or to 0·6098 of metallic arsenic.

Thus, supposing the weight of the sulphide of arsenic was 0·345 grains, this is equal to (0·345 × 0·8049)= 0·277 grains arsenious acid, or to (0·305 × 6098) = 0·210 grains metallic arsenic.

2. Conversion of the Sulphide of Arsenic into Compounds Suitable for Testing.—It is now desirable to make the most characteristic tests for arsenic; some of them are popularly known, and it is expected by courts of justice that they shall be made when arsenic is found in the examination of a case of suspected poisoning; there are others less known, but at least equally distinctive. Now, although it is not necessary to make them all to satisfy a chemist of the presence of arsenic, yet, as in the majority of cases, there is a sufficient quantity present to make all those tests which are deemed satisfactory by medical jurists, and as it consumes but little time, is it not as well to make all, or at least the greater part of them? Any common test omitted is often seized by the defendant's counsel, and is made to appear as the most characteristic, if not the only reliable test. Why not avoid even this slight perplexity? Besides, otherwise the jury may be misled. Again, an accumulation of tests perfectly corresponding with and corroborating each other, is more satisfactory to them.

In fact, the production of a metallic mirror, easily volatilised and readily oxidisable, and which furnishes, by oxidation, octahedral crystals soluble in water, is sufficient evidence of arsenic.

Various plans may be adopted to bring the sulphide

* Communicated by the author, having been presented to the Medical Society of the State of New York.

of arsenic, obtained in the manner just mentioned, into a state fit for making the various tests.

The following method is convenient and simple:—A part, or the whole, of the sulphide of arsenic, according to the quantity obtained, is to be placed in a small porcelain dish, and concentrated nitric acid added and evaporated. This operation is to be repeated a number of times. The residue is to be repeatedly moistened with water, and as often evaporated; by this means every trace of nitric acid is finally removed (a condition essential to the success of the succeeding operations); the sulphide of arsenic is by this treatment converted into arsenic acid. The mass remaining in the dish is dissolved in a small quantity of water, and, if particles of sulphur are present, it is to be filtered, the filter thoroughly washed, and the washings mixed with the original solution. The mixed fluid may be divided into two parts, *A* and *B*.

A is to be divided into two parts, which may be used respectively in (1) Marsh's apparatus, and (2) according to Reinsch's method.

B is to be evaporated nearly to dryness, then thoroughly mixed with twice its bulk of carbonate of soda, and gently heated until perfectly dry. It may then be divided into two parts, to be used respectively in (1) Fresenius' and Babo's apparatus, and (2) in the ordinary reduction tubes.

3. Marsh's Apparatus.—Mr. Marsh, of Woolwich, in the year 1836, proposed an exceedingly simple and delicate method for the detection of arsenic. The principle upon which it is founded may be briefly stated as follows:—

In the presence of nascent hydrogen, arsenious and arsenic acids are deoxidised, water is formed, and the metallic arsenic combines with hydrogen, forming arseniuretted hydrogen gas ($AsO_3 + 6H, = AsH_3 + 3HO$). The simplest form of Marsh's apparatus consists of a bottle closed with a cork containing two perforations, in which are placed a funnel tube and a tube bent at right angles, drawn out to a point at the free end,—zinc and water being placed in the bottle, and a little sulphuric acid added, hydrogen will be evolved; if now a solution of arsenious or arsenic acid be added, arseniuretted hydrogen will be formed. This gas is inflammable, burning with a bluish-white flame. If a cold porcelain plate be held in the flame, a brownish stain of metallic arsenic will be formed upon the porcelain. Berzelius observed that if the tube was heated, the gas was decomposed, and that metallic arsenic was deposited upon its walls. Pfaff and Thompson made, independently of each other, the discovery that antimony formed a similar compound with hydrogen, and that it exhibited phenomena similar to those already noticed in the case of arseniuretted hydrogen. This last discovery destroyed confidence in Marsh's test, until it was found that the two compounds could readily be distinguished.

Marsh's apparatus, as originally proposed, was open to numerous objections; improvements have been made, however, by which these have been very completely removed. The apparatus here described I have used with much advantage, although somewhat more complicated than the form usually employed; it fulfils its objects so perfectly, that the trouble of making it is amply compensated for by its efficiency.

The generating vessel is a Wolfe's bottle; its three necks are closed by corks, in which are accurately fitted a funnel-tube, a syphon-tube,—for drawing off the liquid when in large quantity, without admitting air and long suspending the operation,—and a bulbed tube filled with fragments of pumice-stone or charcoal moistened with sulphuric acid. A tube bent thrice at right angles connects the drying bulb with the drying tube; this has in its lower part, immediately above the constriction, a little asbestos or cotton to prevent the mass above from falling down. The lower half of the tube is to be filled with caustic potash, in fragments the size of a pea; the upper half is nearly filled with fragments of chloride of calcium; finally, a little asbestos or cotton is placed above.

The caustic potash serves two purposes,—that of drying the gas and removing any acid that may be present, which otherwise might prevent the formation of arsenical spots. Thus, if sulphuric acid were carried over, it would liberate chlorhydric acid from the chloride of calcium; and again, if a chlorhydric solution were to be used in the apparatus (which is not to be recommended), the effect above mentioned might occur; the potash removes all danger of this happening. The chloride of calcium serves simply to dry the gas. The mouth of the drying tube is closed with a cork, through which passes a short tube bent at right angles. The reduction tube ought to be of Bohemian glass,—this will not readily fuse, and, being free from lead, will not blacken when heated; it is connected with the mouth of the drying tube by a small bit of rubber tubing. A convenient sized tube is one of about three-sixteenths of an inch external diameter, and about two-thirds of this diameter within. It is advisable to draw out the tube at points from two to two and a half inches asunder, and also at the end of a jet; for a small deposit produced in a constriction may be more distinctly seen than if in another part of the tube. A number of these tubes, thoroughly cleansed, and from twelve to eighteen inches in length, ought to be previously prepared. The tube may be heated by an ordinary alcohol lamp, more conveniently by a Bunsen's gas-burner, enclosed by a sheet-iron case (supported by a perforated cork moving on the stem of the burner), thus preventing the flame flickering by currents of air.

(To be continued.)

THE INTERNATIONAL EXHIBITION.

Jury Awards in Class II., *Section* A.*

Chemical Substances and Products, and Pharmaceutical Products.

MEDAL.

UNITED KINGDOM.

Name of Exhibitor.—Objects Rewarded, and Reasons for the Award.

Albright and Wilson, for production of amorphous phosphorus on a manufacturing scale, production of common phosphorus, excellence and cheapness of products.

Allhusen, C., and Sons, alkali and bleaching powder. For fine specimens illustrating manufacture of soda.

Allen, T., aniline and chemicals. For the production of aniline on the large scale.

Bailey, T., colours for porcelain, glass, &c. For beautiful and extensive collection of colouring matters for porcelain and glass.

Bailey, W., and Son, pure chemicals. For fine specimens.

Bell, I. L., for a collection of raw materials for the production of aluminium. Aluminate of soda, fine specimens of sodium, aluminium, and oxichloride of lead.

* Extracted from the Official Report of the Jury Awards.

Berger, S., and Co., for superior rice starch, with large production.

Blundell, Spence, and Co., for a fine collection of pigments for paintings, oils, and varnishes, manufactured on a large scale.

Bowditch, Rev. W. R., for a new invention intended for the removal of bisulphide of carbon from coal gas.

Bramwell, W., for fine specimens of red and yellow prussiate of potash.

Brodie, B. C., for a new mode of disintegrating and purifying graphite.

Broomhall, T., for starch of superior quality from various grains, with large production.

Bryant and May, for lucifer-matches without phosphorus.

Chance, Brothers, and Co., for fine samples of soda products, particularly fine specimens of sal-ammoniac.

Colman, T. and T., for starch of superior quality, with large production.

Condy, H. B., for manufacture of manganates and permanganates on the large scale.

Cox and Gould, for variety and excellence of specimens, chiefly derived from the distillation of wood.

unell, R. S., for a magnificent collection of artists' and other colours, manufactured by the exhibitor.

Foot, C., and Co., for specimens of pure nitric and other acids manufactured on a large scale.

Gasskell, Deacon, and Co., for a very complete series of soda compounds, including caustic soda.

Hallett, G., and Co., for preparation of antimony used for painting in place of lead.

Hare, J., and Co., for fine samples of pure colours.

Holliday, R., for a collection of the derivatives of benzol and other tar products.

Hopkin and Williams, for superior chemical products.

Hurlet and Campsie Alum Company, for illustrations, by specimens, of the manufacture of alum from alum-schist, fine samples of products, and particularly fine specimens of red and yellow prussiate of potash.

Hutchinson and Earle, for samples of raw materials used in the manufacture of soda, and products of fine quality.

James, E., for superior starch from mandioca, and black lead for household purposes.

Jarrow Chemical Company, for fine specimens illustrating the manufacture of soda.

Johnson and Sons, for the variety and excellence of specimens of lunar caustic, and other chemicals.

Johnson, W. W. and R., and Sons, for fine specimens, showing the different stages in the Dutch process for manufacturing white lead.

Jones, O., and Co., for rice starch of superior quality, with large production.

Kane, W. J., sulphate of soda, chloride of lime, &c., for superior quality of products.

Marshall, Sons, and Co., for a fine collection illustrating manufacture of dyes from lichens, &c.

Melincrythan Chemical Company, for a collection of specimens; acetates and other products derived from the dry distillation of wood.

Metropolitan Alum Company, for producing ammonia-alum in the manufacture of gas.

Miller, G., and Co., for the variety and excellence of products obtained by the distillation of coal.

Newman, T., for very beautiful specimens of artists' colours, with materials used in their manufacture.

Patent Plumbago Crucible Company, plumbago, black lead, graphite. For variety and excellence of articles exhibited.

Perkin and Son, for the first application of aniline for the purposes of dyeing, and for magnificent specimens illustrating the manufacture and application of aniline purple.

Pincoffs and Co., for a new process of extracting a colouring principle from madder root.

Rea, T., shellacs resins, and varnishes. For fine specimens of varnishes, polishes, and the gums used in their manufacture.

Reckitt, I., and Son, starches, blue, black lead. For superior starch from a variety of grains.

Reeves and Son, fine pigments. For splendid display of pigments used by artists.

Roberts, Dale, and Co., chemical products, pigments, and fine colours, &c. For a new process for the manufacture of oxalic acid, and improvements in the production of caustic soda; fine pigments for paper-stainers, &c.; also, specimen of aniline purple obtained by a new process.

Rowney and Co., fine pigments. For a magnificent display of artists' colours.

Rumney, R., illustrations of new chemicals for dyeing and calico-printing. For a collection of new substances introduced for printing and dyeing since the Exhibition of 1851, several of these being manufactured by the exhibitor.

Shand, G., tar and chemical products. For bone oil fit for burning,

Shanks, T., specimens illustrative of the manufacture of chlorine. For illustrations of a new process for the production of chlorine.

Simpson, Maule, and Nicholson, coal-tar products and dyes. For the highest development of manufactures from aniline, for the magnificent display of unrivalled specimens of rosaniline and chrysaniline and their salts, and for the exhibition of all the compounds involved in the transformation of coal into aniline colours.

Smith, B., and Sons, archil, cudbear, orcheline, and lichens from which they are produced. For fine specimens of archil, cudbear, and orcheline, with the lichens from which they are manufactured.

Smith, E., for perfection of apparatus for absorbing carbonic acid from expired air.

Spence, P., alum, raw and calcined shale. For the successful manufacture of alum from ordinary and previously waste coal shale, by dissolving out alumina with sulphuric acid.

Stanford, E. C. C., products distilled from sea-weeds. For new products distilled from sea-weeds.

Stenhouse, T., rare chemicals. For a magnificent display of organic substances scientifically interesting, or applicable in the arts and manufactures.

Stiff and Fry, starch and other products from rice and wheat. For superior starch from rice and wheat, with large production.

Tudor, S. and W., carbonate of lead and white lead. For fine specimens illustrating the manufacture of white lead by the Dutch method.

Vincent, C. W., for varnishes of new composition employed with coloured inks for the machine-printing of chromo-lithographs.

Versmann, T., Wolfram ores, tungstate of soda, and white lead. For the application of tungstate of soda for the purpose of rendering fabrics uninflammable.

Walker Alkali Company, for fine specimens, illustrating the manufacture of carbonate and hyposulphite of soda.

Wallis, G. and T., for variety and excellence of specimens of resins, oils, varnishes, &c.

Ward J., and Co., good illustrations of the production of iodine and several salts from kelp.

Ward, F. O., for an ingenious process used on a large scale for separating vegetable and animal substances, for the use of paper manufacturers.

Whaite, H., for the application of an elastic vehicle, containing caoutchouc, to painting or printing, on tissues used for flags.

White, J. and J., for excellent specimens of bichromate of potash.

Wilkinson, Heywoods, and Clark, for varnishes of superior quality and oxidised oil.

Wilson, J., and Sons, for fine specimens, illustrating the manufacture of alum from alum schist.

Winsor and Newton, for a magnificent display of artists' colours, and for their endeavours to substitute permanent colours for the more fugitive pigments used by artists.

Wood and Bedford, for beautiful specimens, illustrating the manufacture of orchil and cudbear from lichens.

BERMUDA.

Browne, Dr. William, starches. For variety of samples of excellent quality.

BRITISH GUIANA.

Foreman, Mrs., arrowroot. For a variety of samples of good quality.

Rose, Mrs., cassava starch. For a variety of samples of good quality.

CANADA.

Benson and Aspden, samples of Indian corn starch. For the excellent quality of samples.

Canadian Oil Works, for an extensive exhibition of the derivatives of petroleum.

McNaughton, E. A., flour and potato starch. For the excellent quality of samples.

Pearson, Brothers, for an extensive exhibition of the derivatives of petroleum.

CHANNEL ISLANDS.

Arnold, A., for an instructive collection illustrating the manufacture of iodine.

DOMINICA.

Dominica Commission, for a variety of starches of good quality.

INDIA.

Fischer and Co., for excellent quality of their saltpetre.

Government of India, for a collection of manufactured chemicals.

JAMAICA.

Royal Society of Arts, for variety of starches of good quality.

TRINIDAD.

The Corresponding Committee of the Society of Arts, for a variety of starches of good quality.

VICTORIA.

Praagst, for a variety of the secondary products obtained in the manufacture of gas from wood.

AUSTRIA.

Austrian Company for Chemical and Metallurgic Products, for the excellence of products, and vastness of manufacture of soda, and for the manufacture of hyposulphite of soda by a new process.

Breitenlohner, Dr., paraffin and peat oil. For the introduction of this branch of industry in Bohemia; for an improved kind of furnace.

Diez, E., white lead. For the excellence of the products manufactured by the Dutch method, with the sole employment of wood vinegar.

Engelmann, S., albumen. Dextrine. For excellence, cheapness, and extent of production.

Fichtner, J., and Sons, manure and glue. For the excellence of these products.

Fürth, Bernhard, for the great variety of lucifer-matches, their excellent quality and cheapness.

Gosleth, F., for extent of production of chemicals and their excellence. For the introduction of the manufacture of chromate of potassa on a large scale.

Herbert, F. P. Baron, for extent of manufacture of white lead and its remarkable excellence.

Idria, I. R., Mining Office, for exhibition of cinnabar.

Joachimsthal, J. R., Mining Office, for uranium and vanadium preparations.

Kaiser, J. E., chemical colours and starch. For their great varieties and excellent quality.

Lamatsch, Dr. J., chemicals. For their varieties and excellence.

Lehrer, A., for superiority of ultramarine and remarkable cheapness, resisting the action of alum.

Miller and Hochstädter, for extent of manufacture of chemicals and their cheapness. (Soda, etc.)

Moll, A., chemical and pharmaceutical products. For introducing the manufacture of photographic preparations.

Nackh, J., and Son, for the good quality of chemicals combined with cheapness.

Nowack, J., dextrine, and extracts of colouring matter. For the excellence of the lac-like colour pastes, for improvements in their application, and for the discovery of a new substitute for albumen.

Pollak, A. M., matches and chemical lights. For vastness and excellence of manufacture.

Polley, C., coal and mineral tar of petroleum, raw materials of manufacture and plans of apparatus. For the diversity of products, for the variety of their application, and for their extension of production.

Richter, Brothers, and Clar, orchil, weeds, and extracts. Indigo carmine. For the introduction of the branch of chemical manufacture into Bohemia, and for the excellence and cheapness of the products.

Saltworks of Pirano, sea salt. Excellent quality of products.

Saltworks of Venice, sea salt. Excellent quality of products.

Setzer, J., ultramarine. For the introduction of this branch of industry into Austria, and for the excellence of the products exhibited.

Strobentz, Brothers, chemical products. For extensive manufacture and the good quality of colouring matter. Starch and gluten.

Tscheligi, R., protoxide of lead. For the good quality and extensive manufacture of the oxide exhibited.

Wagenmann, Seybel, and Co., chemical products. For their excellent quality, and manufacture on a very grand scale.

BADEN.

Benkiser, for the extent of manufacture and purity of the tartaric acid.

Ultramarine Manufactory, for the remarkable purity of the prussiate of potash and ultramarine, manufactured on a large scale.

BAVARIA.

Adam, F. M., for the good quality of products.

Henfeld Bavarian Joint-Stock Company, for the good quality of chemicals.

Hoffman, G., mineral and chemical colours. For the good quality of products.

Kaiserslautern Ultramarine Manufactory, for the good quality of ultramarine manufacture on large scale.

Lichtenberger, C., œnanthic ether, œnanthic acid, tartar, tartrate of lime, essential oil of French brandy. For the remarkable quality of products manufactured according to scientific principles, and on a considerable scale.

Satter, W., samples of colours. For the excellence of products manufactured on a very large scale.

BELGIUM.

Brasseur, E., white lead, ultramarine. For products excelling in quality and cheapness.

Bruneel, J. J., and Co., for very fine chemical products manufactured on improved principles and adapted for the fine arts. Acids and acetates, vinegars, oil and alcohol from wood.

Cappellemans, J. B., sen., chemical products of very good quality, obtained in large quantities by perfected processes.

Delmotte-Hooreman, Ch., white lead. For beauty of the products, improvements, and economy of the manufacture.

De Wyndt and Co., sulphur in rolls and flowers. For the introduction of this branch of industry into Belgium, and for improvements in the apparatus in a sanitary point of view.

Geeternyen, Van Everaert, starch produced by steam power. For its excellent quality.

Heidt-Cuitis, T., starch, &c. For general excellence, whiteness, and remarkable purity.

Mertens, Balthazar, and Co., lucifer matches. For the introduction of their manufacture into Belgium.

Mertens, G., for inodorous lucifer-matches. Sold at moderate price.

Remy, E., and Co., rice starch. For the introduction of its manufacture into Belgium.

Vander Elst, P. D., sulphuric acid, nitric acid, sulphate of soda, copperas, bleaching powder, crystals of tin salt. For excellence and variety of products and well-conducted manufacture with the view of protecting health.

BRAZIL.

Faro, T. P. D., and T. D. De, starch. For the good quality of the samples.

Santos, M. E. C. Dos, and Son, organic and inorganic chemicals. For a beautiful collection of products.

DENMARK.

Benzon, A., chemical, photographic, technical, and economical preparations and articles. For the variety and excellence of preparation.

Weber, Th., and Co., cryolite and its products. For their good quality.

FRANCE.

Bezançon, Bros., for the good quality of white lead, manufactured on a large scale, and for introducing the grinding of the white lead in oil with the view of preserving the health of the workmen.

Boyer and Co., for distillation of wood in the forest, and for the good quality of products thereby obtained.

Brunier, Son, and Co., prussiates of potash. For the good quality of their products manufactured on a large scale.

Bruzon, J., and Co., for the improvements of Thénard's process for the manufacture of white lead, and for obtaining a zinc white of increased density or body.

Camus, C., and Co., for the good quality of products obtained on a very large scale by the destructive distillation of wood.

Cazalis, H., and Co., for his potash alum obtained from sea-water salts, and especially for having developed the manufacture of tartaric acid by Mr. Condy's process, consisting in the utilisation of the tartrate of lime lost in the manufacture of cream of tartar.

Charvin, for having succeeded in extracting from *Rhamnus Catharticus* a green colouring matter apparently identical with the Lakao of the Chinese.

Coëz, E., and Co., for the good quality of their extracts of dye-woods, and for the introduction of lakes into dyeing.

Coignet, Son, and Co., and Coignet, Brothers, and Co., for the extent of their manufacture, and especially for the employment of amorphous phosphorus in the manufacture of lucifer-matches, which they produce on an increasingly large scale.

Collas, C., and Co., for having popularised the detergent properties of the light oils of coal-gas naphtha, and for having, by the production of nitro-benzol on a considerable scale, indirectly contributed to the development of the aniline industry.

Cournerie, Son, and Co., for having utilised a new source of potash salts, consisting in the extraction of the alkali from the soapy matter contained in sheep's wool.

Defay, J. B., and Co., for preparing albumen from the serum of blood as a substitute for that from the white of eggs.

Dehaynin, M. G., for the good quality of the products, the importance of the manufacture, and for the employment of an improved apparatus for obtaining benzol of a better quality.

Deiss, E., for the manufacture of bisulphide of carbon on a large scale, and for the employment of this substance in a peculiar apparatus for the extraction of fatty substances from residues hitherto lost.

Delacretaz and Clouet, for the excellence of their products, especially of their bichromate of potash.

Deschamps, Bros., for the great beauty of their blue ultramarine; employed for staining paper and dyeing cotton yarn.

Desespringalle, A., chemical products obtained from alcohol and tar, salts of cadmium. For the good quality of products manufactured on a large scale.

Dornemann, G. W., for the good quality of his products, and for improvements in the construction of furnaces.

Drion-Quérité, Patoux, and Drion, for the good quality of their products manufactured on a large scale.

Duret, sen., and Bourgeois, for the good quality and cheapness of their colours, free from poisonous ingredients.

Fayolle and Co., for the good quality of their aniline colours produced on a very large scale.

Fourcade, A., and Co. For having established and enlarged the works of Tavelle, and for having largely increased the amount and good quality of the products which it furnishes to commerce.

Fournier, Laigny, and Co., for the good quality of their products and for the employment of close retorts for the carbonization of the wood on the spot.

Galland, Rob., and Co., for the good quality of products manufactured on a large scale.

Gautier-Bouchard, L. J., for the importance and variety of production, and for having successfully, and on a a large scale, obtained Prussian blue from the residues derived from the purifiers of gas factories.

Gélis, A., for the good quality of products introduced by him, and for the invention of a new and rational mode of manufacturing yellow prussiate of potash, and for products obtained by this.

Gillet and Pierron, for the fine quality of their black dye, and the employment of a new astringent principle.

Guimet, J. B., for the creation of the ultramarine industry; for the excellence of the products which he continues to manufacture.

Guinon, Marnas, and Bonnet, for the discovery of an archil colour which resists the action of acids, and for the direct manufacture of a blue colouring matter from carbonic acid.

Huillard and Grison, for the good quality of their products, and improved processes of preventing the deterioration of colouring matters.

Jaques-Sauce, for the good quality of his colour pastes and the superior brilliancy of the cochineal red which he exhibits.

Joint-Stock Glass Company of St. Gobain, Chauny, and Cirey, for the importance of the manufacture and superior quality of the products.

Kestner, C., for the excellence of the products and for the manufacture on a large scale of the new chromium green called "Guignet's green."

Knapp, for the good quality of his products, which he produces on an increasingly large scale.

Kuhlmann and Co., for the extent of his manufacturing enterprise and for the excellence of his products; also for the great services which M. Kuhlmann rendered to industry by developing the manufacture of the alkaline silicates for new purposes, and for the utilisation of the waste liquors from the preparation of chlorine in the transformation of sulphate of baryta into chloride of barium.

Lalouël de Sourdeval and Margueritte, for the extraction of ammonia from sewage by means of an improved apparatus, and for the manufacture of ammoniacal salts employed as manures.

Lamy, for the discovery of new and abundant sources of thallium.

Lange-Desmoulin, J. B. C., for the good quality of his products.

Laroque, A., for having first introduced the manufacture of nitro-benzol, of which he now manufactures a large amount, and for his efforts of extracting useful products from the residue of the manufacture of cider.

Latry, A., and Co., for good quality of products and extent of manufacture and improvements of processes.

Laurent, F., and Casthélaz, for the good quality of their aniline colours manufactured on a large scale; also for a direct process of transforming nitro-benzol into a red dye,

Lefebvre, for the production of potash from beet-root on a large scale, and for the extraction of salts of rubidium.

Lefranc and Co., for a collection of various colours of good quality.

Mallet, A. A. P., for his process of purifying coal gas, and for the utilization of the ammonia contained in the gas.

Maumené and Rogelet, for having utilized a new source of potash salt, consisting in the extraction of the alkali from the soapy matter contained in sheep's wool.

Merle, H., and Co., for having invented an improved process for the extraction of sulphate of soda and chloride of potassium from sea water by the application of artificial cold, and for the introduction into their works —established for the production of the derivatives of common salt which it furnishes of superior quality— the manufacture of aluminium and of aluminate of soda.

Messier, for the fine samples of lacs employed in the manufacture of stained papers.

Mining Company of Bouxwiller, chemical products and various salts. For the excellence of products manufactured on a large scale.

Parisian Gas Lighting and Heating Company, for the good quality of their products, the importance of their manufacture, and for the partial transformation into benzol of the heavy coal oils.

Peterson, F., and Sichler, for the commercial manufacture of murexide, and for the good quality of their aniline colours.

Picard and Co., for the good quality of their products, manufactured on a large scale, and especially for the direct employment of the mother liquors of varech for the preparation of nitrate of potash.

Poirrier and Chappat, sen., for the good quality of their aniline colours manufactured on a very large scale.

Pommier and Co., for the good quality and variety of chemical products manufactured on a large scale.

Poulenc-Wittmann, E. J., for the good quality of their products manufactured on a large scale.

Renard, Bros., and Franc, for the industrial development of the production of aniline red; for having been the first to engage in the manufacture on the large scale of aniline red; for having expanded this new industry to colossal proportions; and for a splendid display of fuchsine and other colours derived from aniline.

Richter, B. and F., for the good quality of their ultramarine manufactured on a large scale.

Rocques and Bourgeois, for the good quality of their products, and especially for the introduction of Melsen's process for the manufacture of crystallised acetic acid on a large scale.

Sambre and Meuse, Joint-Stock Mining Company of, for the good quality of products manufactured on a large scale.

Schaaff and Lauth, for the practical application of E. Kopp's process for the extraction of the colouring principle of madder.

Serret, Hamoir, Duquesne, and Co., for the extraction and purification of potassa salts obtained from the residues of beet-root.

Serbat, L., mastic, oils, and fats, &c. For the good quality of his products, which are extensively used.

Tissier, Ainé, chemical products obtained from sea wrack. For the importance of the manufacture and the good quality of the products.

FRANKFORT-ON-MAIN.

Brönner, J., aniline colours, creosote, products of tar, &c. For good quality of products derived from coal-tar.

Strassberger and Kurz, dried yeast.

HANOVER.

Schachtrupp and Co., for good quality of white lead and sugar of lead.

GRAND DUCHY OF HESSE.

Blaufarbwerk (Marienberg), for excellence of ultramarine manufactured on a large scale.

Mellinger, C., for good quality of products manufactured upon a large scale, and for the particular beauty of the shellacs.

Oehler, K. and R., for the good quality of products derived from coal-tar.

Schramm, C., varnish and ivory black for printing. For good quality of products manufactured upon a large scale.

ITALY.

Contessini, J. and W., salts of quinine, caffeine, santonine, morphine, mannite. For the good quality of their products manufactured on a large scale.

Convent of the Padri Serviti, for the good quality of products and for the merit of having applied substances previously valueless to useful purposes.

Dol, B., lessee of the Commacchio Royal Salt Works, sea salt. For good quality of products obtained on a large scale.

Dufour, Brothers, mannite, quinine, cinchonine, cinchonidine, and chinoline. For the beauty and copious production of the aforesaid products.

Düval, Henry, for excellence of products, and especially for having established near Monterotondo artificial Boran-soffioni by means of artesian wells.

De Lardarel, Heirs of Count, for having extended the manufacture of boracic acid founded by Count Lardarel.

Factory of Salt, for the good quality and abundant production of sea salt.

Miralta, for excellent quality of products manufactured on a large scale.

Sclopis, Brothers, for the production of sulphur acids from pyrites on the large scale.

ROME.

Government Factory of Alum at Tolfa, alum extricated from alum stone. For the well known excellence of the products.

NETHERLANDS.

Elst and Matthes, Van Der, for good quality of products obtained on a large scale, by utilising the ammoniacal liquors from gas factories.

Garancine and Madder Manufactory, for the good quality of the products, also for manufacturing alcohol from sugar contained in madder.

Mendel Bour and Co., for the good quality of the products, and for the great purity of the alcohol extracted from madder.

Noortveen and Co., for the extensive manufacture of chromium colours.

Ochtman, Van der Vleit, and Co., for the extensive manufacture of madder and garancine.

Duyvis, T., Urling's starch, and gluten from refuse. For excellence of products extensively manufactured.

Smits, Widow, P. and Son, bone-black, sulphuric acid, nitric acid, sulphate of iron. For excellence of products.

NORWAY.

Chrome Manufactory of Leeren, salts of chromium. For the beauty of the products.

PORTUGAL.

General Portuguese Wood Administration, turpentine,

acids, essences, resin, charcoal, &c. For the good quality of products manufactured on a large scale.
General Society of Chemical Products, for the local importance and the excellent quality of the products manufactured by the Society.
Novaes, M. J. V., sea salt. For the good quality of products manufactured on a large scale.

PORTUGUESE COLONIES.

Consielho Ultra Marino de Portugal, exhibition of chemical and pharmaceutical products. For the extent and variety of the collection of articles exhibited.
Welwitsch, F., Dr., chemical and pharmaceutical products of Angola. For a remarkable collection of products.

PRUSSIA.

Beringer, A., for the beauty and variety of colours free from arsenic.
Beyrich, F., for the purity and beauty of the preparations.
Curtius, J., for the variety and excellence of products of ultramarine.
Georg-Hütte, for the beauty of the paraffin manufactured on a large scale.
Hermann, O., for the great variety and purity of preparations of chemical products.
Heyl, R., and Co., for the variety of products manufactured on a large scale, and for their green colours free from arsenic.
Hübner, Dr. Bernhard, for the beauty of the paraffin and oils, and for the development of this branch of chemical manufacture in Germany.
Jäger, C., for the beauty of his aniline preparations.
Kruse, A. T., for the excellent quality of starch, manufactured on a large scale.
Küderling, H. F., for the purity of the products manufactured on a large scale, and for the beauty of the prussiate of potash.
Lander and Krugman, for the excellent quality of starch, manufactured on a large scale.
Leverkus, Dr. C., for the beauty of the ultramarine.
Mathes and Weber, for the excellence of products, and more especially of their soda manufactured on a large scale.
Runge, Prof., Dr., for the influence which his researches has exercised on the development of the industry of coal-tar.
Sächsisch Thüringische Actien Gesellschaft, for the beauty of the paraffin and oils, and for the development of this branch of chemical manufacture in Germany.
Sarre, H., jun., for extensively applying the residue of fatty matter obtained in washing wool, &c.
Schering, E., for a collection of beautiful photographical preparations; more especially for fine specimen of pyrogallic acid.
Wierschen Weissenfels Actien Gesellschaft, for the beauty of the paraffin and oils, and for the development of this branch of chemical manufacture in Germany.
Weiss, J. H., and Co., for the beauty and purity of their madder colours.

RUSSIA.

Epstein, A., and Levy, copperas, Roman vitriol, white lead, Glauber's salt, and saltpetre. For variety and good quality of products.
Heesen, for his matches without phosphorus.
Pitancier, for the good quality of the chemicals exhibited.
Reichel, A., birch, bark, oil, and turpentine. For the good quality of the specimens.
Sanin, V. J., for the good quality of the chemicals exhibited.
Shipof, A., for the good quality of the chemicals exhibited.
Tornau, Baron, and Co., for their new materials for illumination.

SAXONY.

Duvernay, Peters, and Co., for a collection of aniline and archil colours and other chemicals of good quality.
Würtz, T., for the excellent quality of aniline colours.

SPAIN.

Berrens, H., for a beautiful collection of colouring matters, chiefly lake colours.
Cros, J. T., for sulphuric acid and its derivatives, manufactured on a large scale.
Gallardo, L., starch from the Yarrow. For the good quality of his samples.
Jose, Lacambra, starch. For good quality of products.
Jose, Mengibar, and Merez, crude and purified saltpetre. For the good quality of their products.
Pedro Garcia, starch. For the good quality of products.

SWEDEN.

Associated Copper Smelters, Fahlun, oxide of copper, copperas, sulphur, sulphate of copper. For fine specimens of the articles mentioned.
Friestedt, A. W., for animal charcoal of good quality, manufactured on a very extensive scale.
Hjerta, L. J. and Michaelsson, for sulphuric acid, manufactured on a very extensive scale.
Jönköping Lucifer-match Company, for lucifer-matches made with amorphous phosphorus.
Lewenhaupt, Count C. M., turpentine, pinol, resin, lampblack. For the excellent quality of the products manufactured on a very large scale.

SWITZERLAND.

Müller, J. J., and Co., for the beauty and variety of colouring matters derived from madder and aniline, manufactured on a large scale.

UNITED STATES.

Glencove Starch Company, samples of starch. For the excellent quality of products.
Hotchkiss, H. G., winter-green oil. For excellent quality of products.
Kingsford, silver gloss starch. For excellent quality of products.
Pease, S. F., for petroleum, benzol from petroleum, coal-tar oil, for illumination and lubrication.

WURTEMBERG.

Böhringer, C. F., and Sons, for the excellent products, extensively manufactured.
Knosp, R., indigo, carmine, cudbear, aniline colours. For the excellent quality of products, extensively manufactured.
Neubauer, for the excellent quality of starch, manufactured on a large scale.
Renner, J. A., for the excellent quality of starch, manufactured on a large scale.
Schöllkopf, Joh., for the good quality of starch, manufactured on a large scale.
Siegle, H., for excellence and variety of colours, free from poison.

NOTICES OF BOOKS.

A Handbook of Volumetrical Analysis. By Robert H. Scott, M.A., T.C.D. Price 4s. 6d. London: Longmans.

This is a useful handbook to a branch of analysis which is daily becoming more and more general. The advantages of the method of volumetric analysis as compared with those in ordinary use, when the rapid and accurate determination of any one constituent of a chemical compound is desirable, are very evident, and the author has done considerable service to his fellow-labourers in chemistry, by putting together in a compact form a number of the

volumetric processes which have met with most general adoption.

Practical hints are met with in most of the processes. For instance, in speaking of the preparation of infusion of litmus, it is directed to keep the solution in an *open* bottle, as, if the air be not allowed access to it, it is very liable to undergo decomposition; the rationale of this is not easy to see.

In the choice of a protosalt of iron which should not be liable to the inconvenience of being easily oxidised by the action of the air, the author has adopted Mohr's useful suggestion of using the double sulphate of iron and ammonia, FeO,SO_3+NH_4O,SO_3+6HO. This salt is easily obtained in crystals from a solution in which 139 parts of green vitriol and 66 parts of sulphate of ammonia have been dissolved. The crystals are hard and preserve their transparency perfectly, thereby showing that no alteration has taken place in their constitution. Two equivalents, or 392 parts of this salt are required to absorb one equivalent of oxygen.

For liberating the carbonic acid from a corked bottle in which it exists in solution under pressure, (Seltzer-water, for instance,) an ingenious contrivance is adopted. To one of Mohr's cork borers a piece of india-rubber tube is attached, the other end of which slips over a glass tube plunging into a vessel filled with liquid ammonia. At a distance from the end of the borer, slightly greater than the thickness of the cork, a small hole is pierced in the side of the borer. On boring the cork the plug carried down stops the tube until the lateral hole comes below the lower surface of the cork, when effervescence commences. The carbonic acid is conducted by the tube into the ammonia, where it is fixed. This plan of opening a soda-water bottle might be found useful for other than analytical purposes in a chemical laboratory.

The work professes to be mainly a compilation from Mohr's "Titrir-methoden," and Schwarz's "Mass-analyse," and the author is also indebted to Professor R. Schneider for many valuable hints. The student in this branch of analysis will not, however, consider this want of originality to interfere with the value of the book, for his object will be to learn the processes whose value has been proved by experience, and is universally admitted: he will here find rapid and accurate methods for the estimation of acids, alkalies, iron, manganese, ferrocyanide of potassium, zinc, lime, lead, nitric acid, indigo, phosphoric acid, iodine, sulphurous acid, hyposulphite of soda, sulphuretted hydrogen, arsenious acid, chlorine, chlorates, bichromate of potash, peroxide of manganese, cyanogen, silver, mercury, copper, urea, and sugar. Most, if not all of these processes have been published before, but our thanks are not the less due to Mr. Scott for collecting them together in one volume and giving them in so convenient a form to the English chemist.

A Dictionary of Dyeing and Calico-Printing. By Charles O'Neill, F.C.S., Analytical Chemist, Author of "Chemistry of Calico-Printing and Dyeing." Part I. Price 1s. Manchester: A. Ireland and Co. London: Simpkin, Marshall, and Co.

This promises to supply a want which has long existed. Technical works on various branches of manufactures are not rare, and the calico-printer and dyer has no reason to complain of the want of works of reference in that special branch of applied chemistry; and within the last year or so we have had occasion to notice in these columns a very excellent book on the chemistry of calico printing, bleaching, and dyeing, by Mr. O'Neill.

A dictionary of any branch of manufacture, if well arranged, and written by a properly-informed person, has the advantage over a treatise on the same subject, inasmuch as the information required is contained in it ready cut and dried, and the inquirer has only to turn to the desired alphabetical heading to find what he wants. The first part of the Dictionary now before us extends from "Absorbent" to "Chocolate Colours," and includes everything of importance to dyers which could be looked for under these letters. The author promises to complete the work in five or six parts; but if, as is not often the case in Cyclopædias, the concluding letters of the alphabet are to be treated with the same fulness as those at the commencement, we fancy seven or eight parts will be required, and we trust this number will be given.

The author's introductory remarks are very good, and for the benefit of our younger readers we transcribe that portion of them which relates to the receipts, as it will apply quite as forcibly to chemists as to dyers. He says:—

"Many receipts are given in the body of the work; it is not necessary to say to practical and experienced colour-mixers and dyers what amateurs must be strongly reminded of, that receipts in themselves are valueless without preliminary experience. The failure of a receipt, in nine cases out of ten, is not necessarily a condemnation of its correctness, but is frequently a reflection upon the skill of the operator. The real use of receipts in a work of this nature is to show how things have been done by some one in some particular circumstances and with certain materials; and to suggest to another person in another place, with materials of a similar nature but not exactly the same, how he may hope to obtain equal results. Receipts should be looked upon rather as valuable hints than as arbitrary prescriptions."

If the remaining parts of the work are equal to the one now in our hands, it will prove a most valuable and indispensable work of reference to all engaged in this branch of manufacture.

NOTICES OF PATENTS.

1695. *Improvements in Economising the Manufacture of Sulphuric Acid, and in obtaining Copper from Ores used in such Manufacture.* P. Spence, Newton Heath, near Manchester. Dated July 3, 1861.

This invention relates to a peculiar mode of calcining ores of copper containing sulphur, for the purpose of obtaining sulphuric acid, and the method described is also applicable to the treatment of ores, for the purpose of obtaining the copper therefrom, according to the usual metallurgical process of roasting, and by a method for which letters patent were granted, November 3, 1860, to the same patentee.* The prominent feature of this invention consists in submitting the copper ores to a gradual process of roasting, in the course of which the ore is passed from one end of the furnace to the other, a current of air being caused to travel at the same time in the opposite direction. The patentee accomplishes this object by the use of a furnace of considerable length, and having several openings at the side for the purpose of introducing apparatus by means of which the transference and removal of the ore may be effected.

1958. *Separating Copper from its Ores.* P. Spence, Newton Heath, near Manchester, and J. Mellor, Manchester. Dated August 6, 1861. (Not proceeded with.)

In carrying out this invention it is suggested to submit the ores to the action of heat in a furnace, in combination either with an acid or with other substances capable of acting in the same manner, with the object of producing an oxide or

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* Chemical News, vol. v. p. 84.

compound of copper, which may afterwards be rendered soluble by the addition of an acid. The native ores, or such as have been used in the manufacture of sulphuric acid, are equally suitable for this mode of treatment. In all cases it is recommended to employ the ore in the state of fine powder.

Mr. Longmaid's process of submitting copper ores to the action of the roasting furnace in contact with common salt is similar in principle, and capable of furnishing the same results as the mode of treatment just now described.

1722. *Procuring a Colouring Matter from the Refuse of Ironstone.* W. Pask, Sydney, Gloucestershire. Dated July 6, 1862.

In carrying this invention into effect the patentee takes the mineral refuse obtained from certain kinds of ironstone worked in the Forest of Dean, grinds it to powder under iron runners, and stirs the material into water contained in a large tank. The gritty matters quickly subside to the bottom, and after a short interval the top liquid may be poured off, holding the finer particles in suspension; by now allowing the coloured water to remain at rest for a period of six hours or more, a sediment is formed, which when collected and dried in a stove is suitable for the purposes of a pigment.

The visitor to the hæmatite mining districts of Ulverstone and the Forest of Dean cannot fail to have remarked the brilliant red colouring of the water-courses, stained with the refuse of the iron mines, and which are ready to deposit the ferruginous particles whenever the rapidity of the current is interrupted by falling into a larger reservoir, or from any other natural cause. The attempt to economise this ruddy pigment is an object well worthy of consideration.

Grants of Provisional Protection for Six Months.

1072. James Childs, Victoria Street, Pimlico, London, "Improvements in the manufacture of wax matches."—Petition recorded April 14, 1862.

1717. Edouard Hottin, Rue de Rivoli, Paris, "A composition for rendering uninflammable linen, flax, silk, cotton, wood-work, and other articles or materials."

1757. Abram Longbottom, Hammersmith, Middlesex, "Improvements in the manufacture of artificial stone."

1796. Joseph Kellow and Henry Short, Delabole, Cornwall, "Improvements in the manufacture of blasting powder."—Petition recorded June 17, 1862.

1821. Bomanjee Muncherjee Mody, Trafalgar Square, London, "Improvements in varnish or polish."

1825. Arthur Warner, Threadneedle Street, London, "Improvements in the manufacture of pigments or paints from certain refuse materials."—Petitions recorded June 20, 1862.

1857. Edward Chambers Nicholson, Atlas Works, Locks Fields, Surrey, "Improvements in the preparation of colouring matters applicable to dyeing and printing."—Petitions recorded June 24, 1862.

1888. Richard Archibald Brooman, Fleet Street, London, "A method or methods of preparing paper for the reception of photographic pictures or impressions, in order that the said pictures or impressions may be transferred to and fixed on wood, porcelain, and other surfaces."—A communication from Jean Théodore Dupuy, Passage du Desir, Paris.—Petitions recorded June 27, 1862.

1904. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels, and in instruments for applying and removing such stopping apparatus."—Petitions recorded June 28, 1862.

1934. James Webster, Birmingham, "Improved apparatus for the manufacture of gas for illumination."

1940. William Mattieu Williams, Handsworth, Staffordshire, "Improvements in apparatus for the distillation of coal and peat and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons."

Notices to Proceed.

261. John Hargreaves, Clifton Cottages, Clifton Road, Peckham, Surrey, "Improvements in the manufacture of pipes or tubes for conveying water, gas, acids, sewage, enclosing electric telegraph wires, and for other purposes, which improvements are also applicable to the manufacture of other vessels and articles, and in the machinery or apparatus connected therewith."—Petition recorded January 31, 1862.

484. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "Improvements in burners for heating by gas."—A communication from Carlstén Richard Meyn, Carlshutte Rendsburg, Holstein.—Petitions recorded February 22, 1862.

1505. Edmund John Bridell, Middle Temple, London, "Improvements in the manufacture of substances artificially coloured, veined or mottled, like marbles or other substances."—Petition recorded May 17, 1862.

564. Patrick Robertson, Sun Court, Cornhill, London, "Improvements in treating yeast, and in the manufacture of ammoniacal salts, and a substitute for animal charcoal."

614. Richard Wright, Albany Road, Camberwell, Surrey, "Improvements in heating and clarifying saccharine fluids."—Petitions recorded March 7, 1862.

640. Richard Archibald Brooman, Fleet Street, London, "Improvements in producing, by the aid of photography, copies of maps, charts, plans, and drawings."—A communication from Arthur Guy Morvan, Paris.—Petition recorded March 10, 1862.

1084. Alfred Vincent Newton, Chancery Lane, London, "Improvements in the manufacture of blasting powder."—A communication from Frederick Wynants and Prosper Esselens, Ixelles, Belgium.—Petition recorded April 15, 1862.

CORRESPONDENCE.

Mr. Horsley's Test (?) for Strychnine.

To the Editor of the Chemical News.

Sir,—Mr. Horsley has now published facts which readily explain how he fell into the error of asserting that the nitro-prusside of sodium was a colour-test for strychnine. The reagent which he employed and thought pure nitro-prusside of sodium, proves to be, by his own admission, that compound containing as an impurity a "tolerable quantity" of one of the acknowledged best colour-tests for strychnine—a ferridcyanide. Those of your readers who have paid attention to this controversy were doubtless as fully prepared to see this admission as I was, and as little prepared to see the author of such a mistake passing by inference such an exalted opinion upon himself as Mr. Horsley has in the commencement of his letter. The fact of having neglected to ascertain the purity of a re-agent while "studying a series of new tests for the alkaloids," is no fitting subject for self-glorification.

Mr. Horsley, notwithstanding his imperfect knowledge of the constitution of the reagent he employs now under the name of his "extemporaneous compound," still persists in the statement that it is the most delicate test known, and gives a table of some comparative results in confirmation. It is to be regretted that he has not, prior to making this assertion, made himself better acquainted with the results of other experimenters using the ordinary colour-tests. I shall, however, confine my observations to the bichromate of potash, which he regards—and it is but fair to add, Dr. Letheby also—as the least delicate. There is, no doubt, much dependent upon manipulation,

or such discrepancies could not exist as are shown in the following table,—bichromate of potash and sulphuric acid being used :—

		Grain.
Dr. Letheby and Mr. Horsley detected		$\frac{1}{5000}$th of strychnine
Dr. Christison	,,	$\frac{1}{12000}$th ,,
Dr. Redwood	,,	$\frac{1}{20000}$th ,,
Dr. De Vry	,,	$\frac{1}{60000}$th ,,
Mr. Herapath	,,	$\frac{1}{80000}$th ,,
Mr. Jenkins	,,	$\frac{1}{100000}$th ,,
Messrs. Rodgers and Girdwood	,,	$\frac{1}{100000}$th ,,

I must here state that although I have given $\frac{1}{100000}$th part of a grain as my limit, it is not strictly true, as by following directions published by me in *The Lancet* of 1856, a much smaller fraction of a grain can be detected. Mr. Horsley, in applying his test, adds the sulphuric acid last. I need scarcely observe that this must never be done where a trustworthy result is desired, as the test for strychnine consists in no colour from sulphuric acid alone, and its subsequent development on the addition of one of the well-known agents.—I am, &c.

J. E. D. Rodgers,
Formerly Lecturer on Chemistry at the St. George's School of Medicine.

41, Denbigh Street, Pimlico, July 30.

MISCELLANEOUS.

The Polytechnic Institution.—The Directors of this Institution recently invited a large number of scientific men, both English and Foreign, to witness some new electrical experiments and other entertainments, which the energetic and talented manager, Prof. Pepper, has brought together in that deservedly popular scientific Institution. The large plate-glass electrical machine (constructed for the First Napoleon), occupied the centre of the large hall, and served to illustrate a brief lecture which Mr. Pepper gave on the science. The experiments were of the most brilliant and interesting description, and were such as not only to be regarded with amazement by the general visitors, but also with admiration by the eminent savants who honoured the assemblage by their presence. The building was illuminated by four electric lights, which literally converted night into day. Mr. Atkinson was also there with his gigantic induction coil, which was occupied during part of the evening in generating flashes of lightning, each sufficient to knock an ox down at the rate of twenty or thirty a minute. Telegraphic communication was opened between the Institution and St. Petersburg, Paris, Vienna, etc., whilst Captain Bolton was present with his lime-light, passing signals to Highgate Church. Mr. William Sowerby likewise contributed greatly to the evening's entertainment, allowing the visitors to inspect a unique collection of relics from Delhi, Cawnpore, &c. The intellectual part of the entertainment was enlivened by a most agreeable selection of vocal and instrumental music, whilst the whole of the company, from the most learned Professor to the youngest lady, were equally delighted and entertained at the wonderful and veracious account of "Blue Beard," so affectingly recounted by George Buckland, Esq., and so amusingly illustrated by the dissolving views. Refreshments of various kinds were provided, and the evening passed off with more *éclat* than any similar entertainment which we have had the pleasure of attending at this Institution.

Venetian Water Cisterns.—The city of Venice is wholly supplied with rain water, which is retained in cisterns. The city occupies an area of about 13000 acres. The annual average fall of rain is 31 inches, the greater part of which is collected in 2077 cisterns, 177 of which are public. The rain is sufficiently abundant to fill the cisterns five times in the course of the year, so that the distribution of water is at the rate of 312 gallons per head. To construct a cistern after the Venetian fashion, a large hole is dug in the ground to the depth of about 9 feet. The sides of the excavation are supported by a framework made of good oak timber, and the cistern has thus the appearance of a square truncated pyramid with the wider base turned upward. A coating of pure and compact clay, 1 foot thick, is now applied on the wooden frame with great care; this opposes an invincible obstacle to the progress of the roots of any plants growing in the vicinity, and also to the pressure of the water in contact with it. No crevices are left which might allow the air to penetrate. This preliminary work being done, a large circular stone, partly hollowed out like the bottom of a kettle, is deposited in the pyramid with the cavity upward; and on this foundation a cylinder of well-baked bricks is constructed, having no interstices whatever, except a number of conical holes in the bottom row. The large vacant space remaining between the sides of the pyramid and cylinder, is filled with well-scoured sea sand. At the four corners of the pyramid, they place a kind of stone trough covered with a stone lid pierced with holes. These troughs communicate with each other by means of a small rill made of bricks, and resting on the sand; and the whole is then paved over. The rain water coming from the roofs of the buildings runs into the troughs, penetrates into the sand through the rills, and is thus filtered into the well hole by the conical holes already described. The water thus supplied is limpid, sweet, and cool.—*Scientific American.*

Quartz Crushing and Amalgamating Gold.—The Esmeralda California *Star* gives the following description of operating gold quartz at the Pioneer Mills in Esmeralda:—This mill is run by steam power, using a rotary battery and running eight stamps; its capacity with double screens on is to crush four and a-half tons per day; without screens, it can crush from five to six. The rock while being crushed is fed with hot water, which causes the amalgamation to work more readily. The pumice passes off through a spout into what are called "Howland's amalgamating pans;" thence into an arastra, and from thence into a precipitating or amalgamating vat, and is then conducted into what are called "Varney pans," which act as mullers, and grind the pumice down to a perfect pulp, when the final amalgamation is completed; this pulp is now greatly reduced by water, and is carried off by a spout and flows over blankets; these latter catch and retain the sulphurets and the finer particles of metal which the amalgamators fail to gather; the blankets are then washed by hand, and the sediment is reduced by what is termed the "Hatch process," which is extensively used at Virginia and Gold Hill. This mill is now crushing rock from the "Wide West" ledge, the owners having a contract to crush 1000 tons. From a crushing of twenty-seven tons of rock from this load, a sum of $3126 83 or an average of $115 80 per ton was realised; this was independent of the blanket washings, which would increase the returns to a fraction more.

ANSWERS TO CORRESPONDENTS.

X. Y. Z.—A method of using albumen as a mordant is given in the first part of Mr. O'Neill's "Dictionary."

Young Chemist.—It is certainly not a property of picric acid. Perhaps your specimen of acid contained free nitric acid which acted on the cork. The Numbers will be forwarded on application at our Office.

A Subscriber.—We will inquire, but we not think the thing is possible.

An Old Subscriber.—We believe all Mr. Williams's researches are given in the *Proceedings of the Royal Society*

A. P.—Consult the work reviewed in the present Number.

Purification of Water.—Condy's Patent.—A correspondent writes to ask whether the suggestion to purify water by means of the alkaline permanganates was not first suggested by Forchhammer, the Danish chemist, and through what channel he made the suggestion?

THE CHEMICAL NEWS.

VOL. VI. No. 140.—August 9, 1862.

THE BRITISH PHARMACOPŒIA AND ITS WEIGHTS.

THERE would seem to be no prospect of the New British Pharmacopœia seeing the light this year, nor, indeed, until the next has far advanced. First of all, it would appear that an Act of Parliament will be necessary to make its use compulsory all over the Kingdom, and the Home Secretary had too much on his hands to introduce such a Bill this last Session. Next, it seems that opposition has sprung up against the proposed alteration of the weights, and that in an unexpected quarter. The attention of the College of Physicians was formally called to the proposed innovation, and that learned and influential body immediately passed the following resolution, and communicated it to the Medical Council:—

"It having come to the knowledge of this College that, in the new Pharmacopœia intended for publication under the authority of the General Medical Council, it has been contemplated to introduce a new grain, differing from the standard grain weight of the country, the College is of opinion that, however desirable it may be to substitute the avoirdupois pound for the troy pound, it is *not* desirable to introduce a new grain differing from the standard grain, which has been so long in general use, and is established by Act of Parliament."

We may at once express our sincere thanks to the College for interfering to prevent what would have been a most inconsiderate, inconvenient, and even dangerous change.

Our readers are no doubt aware of the nature of the change proposed. It was simply to substitute the avoirdupois for the troy pound, to retain the avoirdupois ounce, and to divide this ounce into 480 parts, to be called grains, in order to preserve the numerical values of the subdivisions of the ounce into drachms and scruples. Now, the avoirdupois ounce containing only 437·5 *standard grains*, its division into 480 grains would make that weight just about $\frac{1}{11}$th less than the standard grain, and the same, of course, with the scruple and drachm.

It is not the first time that the College of Physicians have had the same change under consideration. Until 1746 both avoirdupois and troy weights were made use of in the Pharmacopœia,—troy weight in describing the older compositions, and avoirdupois in describing some more recently introduced. The use of two different pounds and two different ounces had then all the inconveniences and offered the same temptations to fraud it does to-day, and the College saw the necessity of having but one system of weights. The choice lay between the troy weight, which had been in general use in pharmacy from time immemorial, and avoirdupois weight, which was comparatively but little used in compounding medicines. The latter was chosen for these reasons. "By this," says the Committee of the College, "our book is kept conformable to the generality of pharmaceutic writings; and in the other way, the apothecaries must have all provided themselves with a new set of drachms, scruples, and grains adjusted to the avoirdupois ounce, and the doses of all medicines prescribed hereafter by these weights would have wanted $\frac{1}{11}$th part of their present quantity."*

Now, the inconvenience of having two sets of weights in use we are quite willing to acknowledge, and we reprobate most emphatically the practice some druggists have of using avoirdupois ounces in compounding medicines which contain expensive ingredients. Nevertheless, we must add our earnest protest against the change proposed by the General Medical Council. The advantages to be derived from the change are comparatively small and doubtful; about the confusion and the danger which would ensue from it there can be no doubt.

We shall return to this question next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Action of Substances of the Sulphur and Phosphorus Groups on Solutions of the Metals, by THEODORE PARKMAN. (*Abridged from his Inaugural Dissertation, Göttingen.*)

(*Continued from page* 46.)

IV. *Action of Precipitated Tellurium on the Solutions of Copper, Silver, and Lead.*

1. Without the Aid of Reducing Agents.—Precipitated tellurium, left four days in solutions of sulphate and acetate of copper, did not unite with any copper. Boiled with sulphate of copper four or five hours, it also remained unchanged. Boiled with acetate of copper, it took up considerable copper. Some of the product of this action, obtained by boiling the tellurium four or five hours with the acetate, consisted of a black powder, containing a few glistening particles, otherwise homogeneous. An analysis of it was made as follows:—The substance was dissolved in aqua regia, and the oxide of copper precipitated by caustic potash, dried, and ignited with nitre and carbonate of potash. To free the oxide entirely from tellurous acid, it was again boiled with caustic potash. After weighing, the oxide of copper was tested for tellurium, and was still found to contain a trace.

0·2671 gramme substance gave 0·0831 oxide of copper.

		Calculated.	Found.
2Cu	63·4	24·82	24·82
3Te	192·	75·18	
	255·4	100·00	

This and the following are, I believe, the only analyses

* "A Narrative of the Proceedings of the Committee Appointed by the College of Physicians to Review their Pharmacopœia," prefixed to the Dispensation of the Royal College of Physicians, London. Translated into English, with Remarks, &c., by H. Pemberton, M.D., &c. London. 1746.

that have been made of a telluride of copper. Gmelin ("Handbook of Chemistry," Eng. Transl.) merely mentions that telluride of copper is pale red, according to Berzelius.

The action of tellurium upon nitrate of silver has been observed by Fischer,—viz., that it acts very freely upon the solution of nitrate of silver, and forms a black powder, which does not assume the metallic lustre under pressure. Fischer does not mention whether the black powder was telluride of silver or metallic silver, but leaves it to be inferred that it was the latter, as the observation is given in connection with the reducing action of the metals upon the salts of silver. That telluride of silver is formed is probable from the analogous action of sulphur upon nitrate of silver, as well as of selenium and tellurium on acetate of copper. The following experiment also makes this probable:—Precipitated tellurium was left four days in solution of nitrate of silver. At the end of that time the solution still contained a large excess of silver. The black powder appeared under the lens to be perfectly homogeneous, and to contain no white flakes of tellurous acid. It was found to contain silver and tellurium, both in large quantity. Now, if metallic silver was precipitated by the tellurium, probably little or no tellurium would remain unoxidised, after being in contact so long with an excess of the silver solution, but would either pass entirely into solution (the hydrate of tellurous acid dissolves in water with tolerable facility—Berzelius), or, if there was not enough liquid present to dissolve the whole, be visible as white tellurous acid.

Precipitated tellurium, boiled a long time with acetate of lead, precipitated no lead.

2. With the Aid of Reducing Agents.—Precipitated tellurium, heated with sulphate of copper and sulphurous acid, united with considerable copper. For analysis of the product of this reaction, a portion was prepared in the same manner as the corresponding sulphide of copper. The substance obtained was a black powder. It was ignited with nitre and carbonate of soda, and the oxide of copper separated from the melted mass by dissolving in water. This method is not to be recommended. The platinum crucible used was attacked somewhat (perhaps because there was not enough nitre), and platinum was thus mixed with the oxide of copper. To separate them, the oxide of copper was ignited a long time, to bring all the platinum into the metallic state, and then dissolved out with nitric acid, and precipitated by caustic potash. A better mode of analysis is that given in the analysis last described.

0·9498 gramme substance gave 0·3818 oxide of copper.

		Calculated.	Found.
Cu	31·7	33·12	32·09
Te	64·	66·88	
	95·7	100·00	

Precipitated tellurium, boiled half an hour with acetate of lead and acetate of the protoxide of iron, did not combine with any lead.

V. *Action of Phosphorus on the Solutions of Copper, Silver, and Lead.*

1. Without the Presence of Reducing Agents.—The action of phosphorus on solutions of copper has already been observed by Boeck, Vogel, and Böttcher, and I have but little new to add to their observations.

Phosphorus, placed in a boiling solution of sulphate of copper, gave at first metallic copper, but this gradually blackened, and by continued boiling appeared to be entirely converted into phosphide. This has been also observed by Böttcher. For analysis, I prepared some of the above phosphide by boiling phosphorus five or six hours with sulphate of copper. The substance obtained was a black powder, the larger particles possessing considerable lustre. Under the lens it appeared to be perfectly homogeneous. Even when finely pulverised, not a trace of metallic copper could be seen. Heated on platinum foil, here and there a very slight flame was observed for two or three seconds. The quantity of free phosphorus, however, if there was any present, must have been extremely small.

For analysis, a portion was dissolved in hydrochloric acid, with the aid of chlorate of potash, the solution heated until it no longer smelled of chlorine, diluted, and the copper precipitated by sulphuretted hydrogen. The filtrate was saturated with ammonia, and the phosphoric acid precipitated by sulphate of magnesia (mixed with chloride of ammonium in sufficient quantity to prevent its precipitation by ammonia). The sulphide of copper was dissolved in fuming nitric acid and the oxide precipitated by caustic potash.

0·6695 gramme substance gave 0·7301 oxide of copper, and 0·2916 phosphate of ammonia-magnesia.

		Calculated.	Found.
7Cu	221·9	87·74	87·06
P	31·	12·26	12·16
	252·9	100·00	99·22

The phosphides of copper previously described are Cu_6P, Cu_3P, and Cu_2P.

Phosphorus in solution of nitrate of silver throws down metallic silver, as observed by Boeck. The silver has the usual colour and metallic lustre, and is apparently crystalline. No phosphide could be seen.

Phosphorus, left three days with a solution of acetate of lead in a closed test-tube, gave merely a few white flakes, probably of phosphate of lead. On boiling, a black precipitate was rapidly formed in large quantity, along with white phosphate of lead. After dissolving out the latter with caustic potash, the black substance was dissolved up in nitric acid, and tested for phosphoric acid. None was found; so that the substance, it would seem, was metallic lead.

2. In the Presence of Reducing Agents.—Solution of sulphate of copper was saturated with sulphurous acid, phosphorus added, the whole heated somewhat, and left three days in a closed flask. On opening the flask, the solution was colourless. The result was metallic copper, and black phosphide of copper, along with unchanged phosphorus. I did not attempt to analyse the phosphide, as it was so intimately mixed with finely-divided metallic copper that it was impossible to obtain it pure.

VI. *Action of Arsenic on the Solutions of Copper, Silver, and Lead.*

1. Without the Aid of Reducing Agents.—Pulverised metallic arsenic, boiled with sulphate of copper, took up considerable copper. For analysis of the product of this reaction, pure metallic arsenic, pretty finely pulverised, was boiled several hours with concentrated solution of sulphate of copper. The substance obtained was a perfectly homogeneous, dark grey powder. It was dissolved up in hydrochloric acid, with the aid of chlorate of potash, and digested at a very gentle heat

with excess of chlorate of potash, in order to make sure of converting all the arsenic into arsenic acid, until the solution was nearly free from chlorine. The solution was then made strongly alkaline with ammonia, and the arsenic acid precipitated by a mixture of sulphate of magnesia and chloride of ammonium. This was washed with water containing considerable ammonia, brought upon a weighed filter, and dried at 100° C. From the filtrate, after acidulation, the copper was precipitated by sulphuretted hydrogen, dissolved in fuming nitric acid, and re-precipitated by caustic potash.

1·0225 gramme gave 0·7211 arseniate of ammonia magnesia ($2MgO, NH_4O, AsO_5 + HO$) and 0·9276 oxide of copper.

		Calculated.	Found.
6Cu	190·2	71·72	72·43
As	75·	28·28	27·83
	265·2	100·00	100·26

The arsenides of copper previously described are Cu_4As and Cu_3As.

Arsenic in solution of nitrate of silver throws down metallic silver, as already observed by Fischer.

2. With the Aid of Reducing Agents.—Pulverised metallic arsenic, heated with solution of sulphate of copper and sulphurous acid, forms arsenide of copper. For analysis, a portion was prepared in the same manner as the corresponding sulphide of copper. The substance obtained was a dark grey, perfectly homogeneous powder. Two arsenic determinations were made, in the same way as in the last analysis.

I. 1·1215 gramme substance gave 1·4189
$2MgO, NH_4O, AsO_5 + 12HO$ (dried *in vacuo*).

II. 0·3235 gramme substance gave 0·2650
$2MgO, NH_4O, AsO_5 + Ho$ (dried at 100° C.).

		Calculated.	Found.	
			I.	II.
5Cu	158·5	67·88		
As	75·	32·12	32·78	32·33
	233·5	100·00		

Pulverised arsenic, boiled half an hour with acetate of lead, precipitated no lead. With acetate of the protoxide of iron and acetate of lead, it also produced no effect.

VII. *Action of Antimony on the Solutions of Copper, Silver, and Lead.*

1. Without Reducing Agents.—Pulverised antimony, left three days in solutions of sulphate and acetate of copper, took up considerable copper, in both cases. A little white oxide of antimony was also formed. By boiling, the action takes place more rapidly, and a large quantity of the oxide is formed.

As already observed by Fischer, antimony precipitates metallic silver from the nitrate. Towards the end of the action, some antimonide of silver is also formed, according to Fischer.

Antimony, boiled a long time with acetate of lead, produced no effect.

2. With Reducing Agents.—Pulverised antimony, left three days in solution of sulphate of copper, mixed with sulphurous acid, combined with considerable copper. No white oxide could be seen. In acetate of copper the same effect was produced.

Antimony, boiled with acetate of the protoxide of iron and acetate of lead, did not throw down any lead.—*American Journal of Science.*

TECHNICAL CHEMISTRY.

Chemistry and the Manufacture of Iron.

(*Continued from page* 296, Vol. V.)

No. III.—Blast.

Very few blast furnace managers will deny the importance of an accurate knowledge of the part the blast plays in the reduction of iron. More of it passes through the furnace than of any other material, and a change in quantity, temperature, or moisture influences materially both the yield and quality of the iron.

We will just look at the immense quantity of air used in one furnace every twenty-four hours. It is calculated that with the blast heated to a temperature of 900° F. about 8 tons of air are required to make 1 ton of iron, and some of the large furnaces in the Middlesbro' district are said to be making 250 tons of iron per week of seven days. This is nearly equal to 36 tons of iron for every 24 hours, or 18 tons a cast: equalling 288 tons of atmospheric air used per day,—1916 tons per week. It is very evident that this immense quantity of air will take with it a very variable amount of moisture, according as the day is damp or dry, and this moisture becomes such an important item in some seasons, that without great care on the part of a manager it will seriously interfere with the working of the furnace. Its effect is to run away with a certain amount of carbon in the furnace, but without evolving an equivalent of heat, thus not only, by its presence, preventing the combustion of the requisite quantity of air in a given time, but also robbing some of the carbon required to produce a given quality of iron. These evils may be met either by increasing the temperature of the blast, or by an addition of carbon. When cold blast was more generally used than it is at the present time, it was well known that the furnace worked better in winter than in summer. This fact is sufficiently accounted for by increase of moisture in the blast during the latter season.

But my object in this paper is to deal more especially with the question of the hot and cold blast. I may say, preliminary, that although an advocate for heating the blast, yet I do not go with those who maintain that there is no limit to the advantages to be derived from this source. I think that beyond a certain point it is not economical to heat the blast, but, at the same time, I believe this point has not yet been attained.

I maintain that the hot blast is superior to the cold blast in three particulars,—viz., it increases the yield, it saves both fuel and flux, and, lastly, it improves the quality of the iron produced.

1st. It increases the yield. Very few will like to deny this fact. Wherever the hot blast has been introduced, its first effect has been to increase the make of iron; and I am told by the manager of one of the largest and oldest established ironworks in the Cleveland district that, by a gradual increase in the temperature of the blast, the weekly make of iron has been increased from 120 tons to above 200 tons.

2nd. It saves both fuel and flux. This is not so well established as the increase of yield. It is admitted by some, but others, as Mr. Truran, maintain that the saving in fuel has been greatly exaggerated, and that the same effects could be produced with a cold blast, in proper

shaped furnaces. Suppose we grant Mr. Truran this. But if a cold blast could do as well in an improved furnace as the hot blast in the present one, what may the hot blast not do? Will it not act as much better in an improved furnace as it does now? If the furnace throat needs widening, why the widening of it will benefit hot as well as cold blast. I believe the results given by Dr. Clark (which will be quoted further on), and think that the same results would be obtained whatever the form of the furnace.

There is another important point which I do not remember ever to have seen referred to in discussions on this subject,—viz., that the hot blast, by decreasing the quantity of fuel to a given result, also decreases the quantity of sulphur and other impurities passing through the furnace. For the purpose of illustration, we will take the results obtained at the Clyde Iron Works, and quoted by Dr. Clark. To make 32 tons of iron (which is about the average daily make at present of hot blast furnaces), 257 tons of coke were required with a cold blast. This introduced into the furnace 2·57 tons of sulphur. With a blast heated to 300° F., 164 tons of coke were found necessary, introducing 1·64 tons of sulphur; and with a blast of 600° F., 72 tons of coke were sufficient, containing only ·72 tons of sulphur,—very little more than a fourth of that introduced with cold blast. The above calculations have been made on the assumption that the coke contained 1·00 per cent. of sulphur.

When we consider the injurious effect on iron of even a very small quantity of sulphur, this fact ought surely to be worth taking into consideration, especially as the decrease in sulphur also involves another saving,—viz., in limestone, and much more than an equivalent quantity; for every ironmaster must know that for every per cent. of sulphur his coke contains he is compelled to use a large excess of limestone to get rid of it.

The question, however, comes here, In what manner does this heating of the blast decrease the consumption of fuel? On this point only a conjecture can be risked, for the changes that take place in the furnace have not yet been fully explained; but there are certain received conditions necessary for the reduction and carbonisation of the iron,—viz., high temperature, a layer of carbon for the reduced iron to pass through, and carbonic oxide to effect the reduction. Now, heating the blast contributes to the above conditions in the following manner:—It gives the oxygen an increased affinity for carbon; so that immediately it enters the furnace, and comes into contact with the coke, combination takes place; consequently the heat is more confined, and, as a result, more intense than when the combustion takes place further up the furnace, as it does with the unheated blast.

Again, the oxygen entering into combination at once leaves the coke a little higher up in the furnace unacted upon, so that it is free to carbonise the iron as it trickles through; and it follows also that if the carbonic acid is formed near the tuyeres, not far from there it must be converted into carbonic oxide, and thus both second and third conditions are observed as well as the first. It is, I believe, by its contributing to the required conditions in such a high degree, and more especially in reducing the space of intense heat, that the hot blast effects such a saving of fuel. A porous coke, in like manner, by offering more surface to the action of the blast, contributes to the above conditions; and for this reason I maintain that a porous coke, if with porosity it combines hardness (so that it may stand the pressure of the "burden"), is the coke best suited for blast furnace purposes.

INTERNATIONAL EXHIBITION.

Class I.

Mining, Quarrying, Metallurgy, and Mineral Products.

(*Continued from page 23.*)

To a large class of our readers—those engaged in mining and metallurgical operations—no section of the Exhibition will be of greater interest than that which is very properly made the first class. The mineral riches of Great Britain may be truly said to be the foundation of all our wealth. It is to the abundance of our coal, aptly defined as "hoarded labour," that we owe our proud position as manufacturers, and the great bulk of our commercial prosperity. Without coal and iron—the nerve and muscle of modern industry,—Anglo-Saxon energy, and the necessities of our insular position might have made us great traders as the Venetians and the Dutch have been; but like Venice and Holland, England might long ago have sunk into comparative insignificance, had she not possessed unparalleled advantages for creating as well as distributing wealth. "While stands the Coliseum, Rome shall stand," was the prophecy of the Anglo-Saxon pilgrims to that city a thousand years ago. And so to-day, the foreign visitor to our International Exhibition may say,—"While England's coal lasts, England's future's safe;" and as the quantity, at the present rate of consumption, is estimated to be sufficient for at least 2000 years, *we* need not be anxious on that score. What may happen when the supply is exhausted we do not care to speculate upon; but at all events, not until then may be expected the advent of that illustrious traveller from New Zealand, who, "in the midst of a vast solitude, shall take his stand upon a broken arch of London Bridge, to sketch the ruins of St. Paul's."

Coals of every variety and from all districts are exhibited in great numbers, and it is not necessary for us to particularise any individual specimen. There are no huge blocks such as made a great feature in the Exhibition of 1851, but the variety is perhaps greater than on that occasion. Some of the specimens, however, will be sure to attract attention,—the lump of Cannel (151), for instance, exhibited for the Earl of Crawford and Balcarres. This looks like a mass of pure bitumen, and a small piece burns with a flame like a candle. There is also a very fine sample of Walls End (336), and some exceedingly good Hartley and Newcastle coals are shown. Patent fuels deserve some notice for several reasons. They use up small coal which would otherwise be wasted, and they economise space in stowage, which is of great importance in our steam-ships. They are less liable to spontaneous combustion, too,—if such a thing has really happened,—and their use would prevent such another catastrophe as that which happened to the *Amazon* some years ago. Some of the specimens here seen look like very useful fuel,—Nixon's (251) and the Aberdare Company (4) particularly.

About the iron and iron ores exhibited a volume might be written, and much that would be useful left unsaid. We can only refer to the more prominent specimens; but must, first of all, recommend the visitor to give particular study to the Case of Dr. Price (286). He will there find a collection of various ores and fluxes, and the resulting metal in several stages of preparation. The specimen of No. 1 pig iron, prepared by Bessemer's process from Cleator hæmatite, is especially deserving of notice, from its very fine quality. A specimen of the

metal which collects at the base of the blast furnace, and contains any titanium which may be in the ores, will also be remarked with interest. The visitor wishing to make himself acquainted with the appearance of siliciferous and graphitous irons, will find samples of these in the case, which altogether well deserves the medal it has earned for its exhibitor.

The Case of Mr. Warner (390) will perhaps be of great interest to chemists. Mr. Warner has processes for depriving bad iron of some of its worst qualities and impurities—silica and phosphorus,—the former, we believe, by means of fluor spar. How far he succeeds in this we will not undertake to say; but he deserves some credit for his ingenuity. The specimens exhibited do not fairly tell their tale, and further explanation of the processes and materials are desirable.

Passing to the iron ores shown, the first deserving of notice is unquestionably the hæmatite exhibited by the Parkside Mining Company (263). These magnificent specimens contain, it is said, 98 per cent. of the peroxide, and average specimens give as much as 95 per cent., with scarcely any impurity but silica. The irons exhibited by the Company have been placed in a bad situation, and have become so rusted that it is impossible to examine the grain. Other hæmatites are exhibited, but do not call for particular notice. Of the Black Band Ironstone, the largest and finest display is by the Scottish Ironmasters (318), but there are several others deserving of notice, particularly the Ebbw Vale and Pontypool Company (95), and the Ynisedwyn Company (429). The Spathose ore, too, is well represented. This is, in some respects, our most valuable mineral, from its yielding the best steel we manufacture. Some of the specimens displayed are in a highly crystalline condition, and at first sight look like marble. Some of that exhibited by the Weardale Company (394) will be observed to be undergoing the change into hydrated peroxide, which occurs when this mineral is exposed to air and moisture.

(To be continued.)

Jottings from the International Exhibition.

How a Medal was Awarded, and Nothing Exhibited.—The visitor interested in building materials who studied an early edition of the Catalogue before going to the Exhibition, would be sure to have noticed, "No. 2339, Siliceous Stone Company, *articles made in artificial stone, &c.*," and would no doubt have wished to examine for himself these interesting and valuable compositions. On reaching the South Court, however, and searching for the display, he would be disappointed in finding nothing but a considerable space marked out with red paint, and labelled with the name of the Company. Inquiry of obliging officials would soon satisfy him that the Patent Siliceous Stone Company had nothing in the department. On repeating his visit he would probably have become accustomed to the disappointment, and if he invested in a more recent edition of the Catalogue, he would have seen that the name of the non-exhibiting Company was expunged. But when the medals and "honourable mentions" were awarded, he would naturally look to see who, in this department, had been fortunate enough to obtain these rewards, and he would read with no little astonishment,—"No. 2339, Siliceous Stone Company, for excellence and durability of material." If an easy natured man, after opening his eyes very wide, he would perhaps regard the thing as a good joke, and conclude that the "excellence and durability" applied to the vacancy. But if curious and very persevering, he might, after much trouble and some correspondence, have received such a note as the following:—

"International Exhibition, 1862.
"Jury Office, 13, Cromwell Road,
"July 18, 1862.

"Gentlemen,—In reply to your letter of the 12th inst., the insertion of the Siliceous Stone Company's name in the list of awards is an error, and will be corrected in the second edition, now publishing.

"I have the honour to be, Gentlemen,
"Your obedient servant,
"Messrs. B. Br." "———

How can the Jurors in this department have done their work, and who is to blame for such an error as this? And how many more of such blunders, we should like to know, have been made?

An Unexpected Result of the International Exhibition.—The *Moniteur* of July 24 publishes a decree levying supplementary dues on several chemicals of English and Belgian origin. These dues are to be paid in addition to and independently of the Customs' duties stipulated by the late Treaty of Commerce. They are as follows:—Caustic soda, 14f.; bicarbonate and silicate of soda, 7f.; hydrate of soda, 3f. 50c.; albuminate of soda, 7f.; hyposulphite of soda, 3f.; crystallised acetate of soda, 3f. This decree should have been published sooner, so that a special vote of thanks to M. Rouher might have been passed at the recent Parliamentary Free-trade banquet to that gentleman.

Parkesine.—A number of pretty and useful articles, formed of a material which the inventor, Mr. Parkes, has named after himself, are exhibited in Case 1112, Class IV. The basis of this material is the mixture of collodion and castor oil, with which our medical and pharmaceutical readers are well acquainted. With this compound the inventor mixes colouring-matters, resins, gums, and earthy matters, according as he wishes, for a plastic, flexible, or hard material, out of which to form medallions, combs, or knife-handles, and the like. The specimens exhibited look pretty as well as useful, and are no doubt durable as long as they are kept out of the fire. A wide field is open for applications of the substance, and Mr. Parkes should get it into the market, and ascertain how far it can compete with similar articles having india-rubber for their basis.

THE INTERNATIONAL EXHIBITION.

Jury Awards in Class II., *Section* A.*
Chemical Substances and Products, and Pharmaceutical Products.

HONOURABLE MENTION.

UNITED KINGDOM.

Name of Exhibitor.—Objects Rewarded, and Reasons for the Award.

Baker, F. B., for good crystals of various salts.
Balkwill and Co., for good specimens of metallic and white arsenic.
Barnes, J. B., for good specimens of organic acid, and others.
Bartlett Brothers and Co., for hardening stone by silicate of alumina.
Bell and Black, for lucifer-matches.
Bouck, J. T., and Co., for tar products and other chemicals.

* Extracted from the Official Report of the Jury Awards.

Boulton and Barnitt, for good specimens of chemical products used as tests, &c.
Bray and Thompson, for good specimens of alum.
Buckley, J. (the trustees of the late), for a fine specimen of sulphate of iron.
Bush, J. W., for good specimens of essences and essential oils.
Cattell, Dr., for varnishes prepared with methylated spirit previously saturated with hydrocarbons.
Chick, G. B., for fine specimens of black lead and stone blue.
Church, A. H., for interesting specimens of rare chemicals.
Cowan and Sons, for animal charcoal.
Darby and Gosden, for beautiful specimens of various sugars.
Dawson, D., for specimens illustrating the manufacture of aniline.
Dunn, A., for an ingenious mode of applying nitrate of silver to the marking of linen.
Dunn, Heathfield, and Co., for good specimens of chemicals.
Emery and Son, for a good collection of colours for porcelain, earthenware, and glass.
Eschwege, H., for specimens of pure wood spirit.
Grimwade, Ridley, and Co., for a cheap paint, containing silica, used for rough out-door work.
Hass and Company, for the preparation of indigo for calico-printers.
Haworth and Brooke, for oxide of tin, and colours prepared for calico-printers.
Hirst, Brooke, and Tomlinson, for chemicals, pharmaceutical preparations, varnishes, &c.
Hynam, J., matches, vestas, and fusees. For lucifer-matches.
Klaber, H., wax vestas, flaming fusees, matches, &c. For lucifer-matches.
Langdale, E. F., for a variety of artificial fruit essences.
Letchford, for lucifer-matches.
Lucas, G., for a mineral composition for filling sunk letters in metallic plates.
Mander Brothers, for fine samples of varnish, and of the gums used in producing it.
Naylor, W., for fine samples of varnish.
Richardson Brothers and Co., for very fine crystals of saltpetre.
Rooth, J. S., for products obtained by the distillation of wood.
Rose, W. A., for colours and lubricating materials.
Smith, T. L. and Co., for white starch from sago.
Smith, T. W., for colours of good quality.
Springfield Starch Company, for starch variously prepared.
Symons, T., for the production of good sulphuric acid and useful oxide of iron from coaly pyrites.
Wilshere and Rabbeth, for varnishes and painters' colours, of good quality.
Wilson and Fletcher, for beautiful specimens of emerald green, chrome yellow, Brunswick green, Prussian blue, and colours derived from aniline.
Wood, E., for specimens of borax and its application.

BERMUDA.

Keane, C. C., for good quality of products of citrate of lime.

NEW BRUNSWICK.

Spurr, D. Wolfe, for products obtained by the distillation of coal.

VICTORIA.

Holdsworth, for samples of pyroxylic spirit.

ANHALT.

Flugger, J. D., for good quality of his varnishes.

AUSTRIA.

Achleitner, L., lucifer-matches. For good quality of articles.
Bode, F. M., for chemical matches for smokers.
Chemical Manufactory (Fiume), for good quality of chemical products.
Hermann and Gabriel, lucifer-matches. For good quality, and of products.
Jäckle, G., for the good quality of products; tartar.
Keil, A., for the variety, cheapness, and excellent quality of his spirit varnishes.
Kühn, E. and C., for the discovery of a method for utilizing the waste chippings of tinned iron in the form of malleable iron, tin, Prussian blue, and ammoniacal products.
Kurzweill, F., for the great variety and excellence of the colouring matters.
Kutzer, J., ultramarine. For excellence of the colouring matters.
Larisch-Mönnich, Count, calcined soda, Glauber salts. For the good quality of his products.
Lehner, E., aniline, substances manufactured from it. For the introduction of this branch of chemical manufacture into Austria; for good quality and moderate prices of products.
Lewinsky Brothers, acetic and acetates. For good quality of products.
Maraspin Brothers, for the excellent quality of the products, and the extent of manufacture (saltpetre, soda, and alum).
Piering, C. F., for extensive manufacture and good quality of sugar of lead exhibited.
Pollak, B., jun., for the extensive manufacture of good potash.
Punschhart, F., and Rauscher, for good quality and cheap production of white lead.
Quapill, R., liquorice juice. For the culture of the root, and the production of a good liquorice.
Sapieha, Prince Adam, for the production of the oil of turpentine in Galicia.
Wagner, Dr. D., for the good quality of his manufactured chemical articles, and the pharmaceutical raw materials.
Wilhelm, F., and Co., drugs and chemicals. For the variety and good quality of their products.
Zarzetsky, J., chemical lights. For the promotion of this branch of industry in Hungary.

BADEN.

Clemm, Lennig, for the good quality of his products of sulphate of copper and other chemicals.
Röther, H., "diamond paint," for protecting wood, iron, and masonry.

BAVARIA.

Graf and Co., for the good quality of coal-tar products manufactured on a large scale.
Meyer, H. (Mittler, F.), for the production of green colour, free from arsenic; much valued in commerce.
Toussaint, G. F., for the remarkable whiteness and purity of the cyanide of potassium.

BELGIUM.

Barbanson, P., animal black and bone dust. For a regular and well conducted manufacture.
De Cartier, A., "Minium de fer d'Anderghem," a preservative paint for iron and wood. For good quality and extensive production.
Coosemans and Berchem, naphtha, photogen, lubricating paraffin, and other oils. For products most esteemed in commerce, advantageously employed in painting and protecting metallic surfaces.
Deltenre, Walker, for a great variety of well prepared varnishes.
Hanssens, B., and Son, fecula, starch, liogomme, gum Arabic, and various pastes. For a great variety and excellence of products presenting all the qualities.
Mathys, M., varnishes. For the good quality of the different products.
Seghers, B., bone black and ivory black. For extensive manufacture and products of good quality.
Vansetter, Coninckx, and Co., turpentine, animal black. For good quality of products.
Verstraeten, E., animal black. For good products and large manufacture.

BRAZIL.

Castro, M. M., and Mendes, chemical products. For a beautiful collection of products.

Gary, M. M. Alexio and Co., a collection of organic and inorganic chemicals. For a beautiful collection of the products.

FRANCE.

Barthe, Durrschmidt, Porbier, and Co., for having, by extracting the alum stone of Monté Doré in works lately established, opened a new source of potash, alum, and sulphate of alumina.

Bertrand and Co., for the good quality of their products of ultramarine blue.

Carof, A. and Co., for the quality of their chemical products obtained from sea wrack.

Chapus, A., ultramarine blue. For the good quality of his products.

Chevé, L. J., jun., for the good quality of their chemical products.

Ferrand, M., for the good quality of colours for artists.

Javal, J., for improving the brilliancy of aniline colours by a process of his own, employed at a factory just established, which has not yet come into full operation.

Lutton, A., Lolliot, and Co., for employing close vessels for the distillation of wood instead of the ordinary mode of carbonisation.

Mathieu, Plessy E., for having manufactured a new innocuous mineral green intended to replace arsenical green; also for the good quality of his products.

Parquin, Legueux, Zagorowski, and Sonnet, ochres, raw and manufactured. For the good quality of their products.

Perra, B., for the preparation of excellent carbazotic acid by employing pure carbolic acid exclusively.

Pérus, J. and Co., for the good quality of their products, and for their endeavours to prevent the inhalation of white lead dust by the workmen.

Piver and Rondeau, A., for the manufacture of copal varnishes of good quality.

Platel, L. J., and Bonnard, J., for cheapening black dyes by the preparation of an extract from chesnut wood in place of that of nut-galls.

Roseleur, A., for the good quality of his products, and for the construction of a balance for the determination of the weight of metal deposited in electro-plating.

Strauss, Javal, and Co., for good quality of their products of dry extracts from dye woods.

Usè, J. C., carmine of saffron in paste, &c. For the good quality of his products.

HANOVER.

Du Bois, J. E., for improved chemical and pharmaceutical apparatus.

Heins, E., for remarkable beauty of tin salt, manufactured by a new process.

Heuer, A., and Co., for good quality of their products of white lead, litharge, &c.

HESSE CASSEL.

Habich, G. C., and Sons, for good quality of colours.

GRAND DUCHY OF HESSE.

Petersen and Co., for good quality of their products obtained by the distillation of coal tar.

ITALY.

Leoni, Antonio, for good quality of products of white lead manufactured by the Dutch process.

Lofaro, B., for the large production of essences, and especially of that of bergamotte.

Mazzuschetti, E., for the production of castor oil on a large scale.

Mellisari, F. S., for the good quality of his products of essence, of bergamottes, lemons, oranges, and almonds, manufactured on a large scale.

NASSAU.

Dietze, H., and Co., for their good products of verdigris and creosote, obtained from beech wood extensively manufactured.

NETHERLANDS.

Groote and Romeny, for good quality of products of chemicals for photography.

Grootes, Brothers D. and M., for the quality of product of powder blue, cocoa, and chocolate, manufactured on a large scale.

Krol, G. J., and Co., bone black. For the quality of product.

Lensing, Collard H., for a method of restoring old engravings.

Reterghem, C. A. Van, and Co., for good quality of products of madder, garancine, fleur de garance, and alizarine.

Society for the Manufacture of Varnish Colours, &c., Molijn and Co., varnishes. For good quality of products.

Taconis, P., for good quality of colours.

Verhagen and Co., for good quality of products of madder and garancine products.

Vriesdendorp, C. A., and Sons, varnish. For the good quality of their articles.

PORTUGAL.

Ferreira, A. J., sea salt. For the good quality of products.

Gouveia, J. M. S., sea salt. For the good quality of products, manufactured on a large scale.

Pires, O. B., sea salt. For the good quality of products.

PRUSSIA.

Andrae and Grüneberg, for good quality of potash, saltpetre, and chloride of potassium, manufactured on a large scale.

Barre, E., for the good quality of his wheat starch.

Behrend, G., for excellence of products of vermilion, sesquioxide of manganese, gum, copal varnish blacking, sealing wax, extensively manufactured.

Bennecke and Herold, for good quality of their lakes and varnishes.

Braune, B., for a fine collection of ambers and succinates.

Bredt, O., for the good quality of his products of colours manufactured from aniline.

Engelbrecht and Veerhof, for good quality of starch and dextrine.

Huguenel, C., for the good quality of his chemical products, soda and bleaching powder.

Lucas, M., for the good quality of cinnabar.

Oster, J. B., for the good quality of his products of succinnic acid.

Pommerensdorf, for the variety of preparations of chemical products manufactured on a large scale.

Ruffer and Co., for the good quality of the zinc-white produced on a large scale.

Ruge, for the beauty of the paraffin and oils, and for the development in Germany of this branch of chemical manufacture.

Schuür, Dr. O., for the good quality of their varnishes.

Schuster and Kähler, for the good quality of their succinates.

Vorster and Gruneberg, for good quality of their potassa preparations, especially saltpetre and potash.

RUSSIA.

Lepeshkin Brothers, garancine. For the quality of the specimens.

SAXE-COBURG GOTHA.

Holzapfel, C. F. and S. F., for the good quality of their products of Paris and steel blue, prussiate of potash, and manganese.

SAXONY.

Pommier and Co., preparations of archil, cochineal, picric acid, salts of alumina, &c. For the good quality of products.

chütz, A., dyewoods, flocks for paper-hangings. For the good quality of the ultramarine.
Theunert and Son, for the good quality of their ultramarine.

SPAIN.

Royo, M., white and red lead. For good quality of products.

SWEDEN.

Djurö Technical Manufactory, for the good quality of the products of sulphate of copper.
Dylta Sulphur Works, sulphur, green vitriol, red ochre, and jewellers' rouge. For the good quality of the substances exhibited.
Hamilton, Count H. D., for the quality of the products of alum, sulphate of iron, and red ochre.
Hazelius, A. K., for the good quality of the product of sulphate of ammonia, largely manufactured for agricultural purposes.
Lofvers Alum Works, for the good quality of their alum.
Piper, Count C. E., for the quality of the products of alum, sulphate of iron, red ochre, and alum waste.
Stora Kopparberg Mining Company, for good specimens of iron pyrites, and red ochre.

WURTEMBERG.

Ziegler, E., for the quality of his product of substitute for bone black, much valued in commerce.

Jury Awards in Class II., *Section* B.

Medical and Pharmaceutical Products and Processes.

MEDAL.

UNITED KINGDOM.

Davy, Macmurdo, and Co., fine collection of mercurial preparations and other chemicals.
Howards and Sons, quinine and other cinchona, alkaloids, mercurial and other inorganic chemical products, and for a fine series of cinchona barks, illustrated by drawings and living plants.
Holland, W., pharmaceutical extracts, essential oils, and dried herbs of superior quality.
Huskisson and Sons, series of fine medicinal chemical products.
Macfarlan, J. F., and Co., products from opium, berberine, &c.
Pharmaceutical Society of Great Britain, for a systematic collection of the drugs and preparations used in English medicine, exhibited under the auspices of the Society.
Ransom, W., pharmaceutical extracts, essential oils, and dried herbs of superior quality.
Smith, T. and H., products from opium, alöin, and caffeine.

INDIA.

Kooney Lall Dey, a large collection of East Indian drugs.

AUSTRIA.

Zacherl, J., exhibition of the flowers of Pyrethrum roseum, and for the introduction of their use into Western Europe as "Insect powder."

BADEN.

Mürrle, G. Jac., steam apparatus for chemical laboratories.

BAVARIA.

Wolffmüller, A., steam apparatus for pharmaceutical laboratories.

BRAZIL.

Peckholt, T., interesting medicinal substances, produced in Brazil, and chemical products obtained from them.
Santos, M. E. C. Dos, and Son, collection of organic and inorganic chemicals.

DENMARK.

Benzon, A., pharmaceutical preparations.

FRANCE.

Armet, De Lisle, and Armet, Vivian, sulphate of quinine.
Aubergier, opium produced in France.
Belanger, an admirable collection of medicinal vegetable substances produced in Martinique.
Berjot, F., pharmaceutical extracts of superior quality.
Callou, A., and Vallée, products of the mineral springs at Vichy, and their preparation for use in foreign countries.
Cavalier, interesting collection of pharmaceutical substances produced in Guadaloupe.
Dubosc and Co., good collection of chemical preparations used in medicines.
Joret, E. M. F., and Homolle, G., digitaline and other pharmaceutical products.

FRANKFORT-ON-MAIN.

Zimmer, C., extensive series of chemical products derived from cinchona bark.

FRENCH COLONY.

Collas, Dr., various medicinal substances from the French possessions in India.
Lepine, J., various medicinal substances from the French possessions in India.
Local Committee in French Guiana for the London Exhibition of 1862, for an interesting collection of drugs produced in that colony.

GRAND DUCHY OF HESSE.

Merck, E., extensive and admirable series of organic chemical products.

ITALY.

Coutissini, F., and Co., sulphate of quinine, mannite, santonine, and other chemical products.
Dufour Bros., organic chemical products of excellent manufacture.

NETHERLANDS.

Junghurn, Dr., specimens of cinchona barks produced in Java, and for his efforts in promoting the culture of the cinchona in Java.

NORWAY.

Möller, Peter, Norwegian cod-liver oil of fine quality, and for a collection of medicinal plants.

PORTUGAL.

Welwitsch, F., interesting medicinal substances collected in Angola.

PRUSSIA.

Marquardt, Dr. L., rare chemical products.

SAXONY.

Heine and Co., medicinal essential oils of excellent quality.
Sachsse, E., and Co., medicinal essential oils of excellent quality.
Schimmel and Co., medicinal essential oils of excellent quality.

SWEDEN.

Cavalli, J. G., medicinal plants dried in the form of compressed cakes.

UNITED STATES.

Philadelphia College of Pharmacy, fine collection of North American vegetable drugs, and preparations made from them.

WURTEMBERG.

Bohringer, C. F., and Sons, quinine and santonine of excellent manufacture.
Wolff, F. A., and Sons, steam apparatus for pharmaceutical laboratories.

HONOURABLE MENTION.

UNITED KINGDOM.

Barnes, J. B., collection of volatile acids and ethers.
Bullock and Reynolds, chemical and pharmaceutical products.
Duncan, Flockhart, and Co., chloroform of excellent quality.
Dunn, Heathfield, and Co., fine crystallisations of gallic acid.
Goodhall, H., apparatus for grinding drugs.
Hopkin and Williams, chemical and pharmaceutical products.
Hulle, J., vegetable alkaloids and their salts.
May and Baker, mercurial and other chemical products.
Squire, P., pharmaceutical extracts of superior quality.

Watts, J., and Co., pharmaceutical extracts of superior quality.

INDIA.

Shortt, Dr., jun., a collection of East Indian drugs.

QUEENSLAND.

Marsh, Miss, Australian manna.

TRINIDAD.

Devenish, Sylvester, specimens of drugs produced in Trinidad.
Knowles, R. J., sulphate of berberine and berberine bark of Demerara.
M'Clintock, collection of medicinal barks from British Guiana.

AUSTRIA.

Hatschek, F., and Sachs, good collection of Hungarian drugs.
Quapill, R., for extract of liquorice of good quality, and for the introduction of the culture of liquorice into Moravia.
Wagner, Dr. D., medicinal essential oils.
Wilhelm, F., and Co., valuable series of drugs and chemicals.

BRAZIL.

Castro, M. M., and Mendes, collection of chemical products used in medicine.

CHINA.

Carey, H. W., collection of drugs found in commerce at Hong Kong, China.

FRANCE.

Garnault, various medicinal products of New Caledonia.
Hardy, Algerian opium and other drugs.
Mercier, various drugs produced in Algeria.
Riche, for cod-liver oil of superior quality prepared in the Islands of St. Pierre and Miquelon, Newfoundland.

HANOVER.

Du Bois, J. E., steam apparatus for pharmaceutical laboratories.

ITALY.

Mazzuchetti, manufacture of castor oil.
Ruspini, G., finely crystallised mannite.
Scerno, E., sulphate of quinine of good quality.

JAPAN.

Myburgh, Dr. F. G., for an interesting series of drugs from Japan.

NETHERLANDS.

Bosson, K. G. W. De, collection of medicinal chemical products.

PRUSSIA.

Geiss, T. G., well prepared essential oils.

SPAIN.

De Ocao, Catalan Jose, saffron of fine quality.
Jobel, collection of medicinal plants from Manilla.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures on Some of the Chemical Arts, with Reference to their Progress between the Two Great Exhibitions of 1851 *and* 1862, *by Dr.* LYON PLAYFAIR, *C.B., F.R.S., Professor of Chemistry in the University of Edinburgh.*

LECTURE VI. (*Thursday, June* 12, 1862.)

The Chemical Arts in Relation to Public Health.—Transformations of Organic Matter; Atmospheric Impurities; Disinfectants and Deodorizers. The Economy of Nature and of Art in respect to Waste Materials analogous.

I HAVE thought it desirable to give the concluding lecture of this course upon a subject on which we have not any great discoveries to relate in the practical arts during the last ten years, but one which is so useful in itself in ameliorating the public health and in improving our comforts, that it seemed a suitable lecture to finish a course upon the industrial arts.

Before we can examine the substances employed to remove the evils which affect the public health, it is necessary to understand what are those evils themselves, and to what sources they owe their origin. I must, therefore, begin by explaining somewhat about the transformations of organic matter, before you are in a position to understand the action of the substances which are employed to stop those transformations.

In the inorganic or mineral kingdom the large variety of bodies constituting it owe the difference of their properties in a great measure to the different elements of which they are composed, or, at all events, to a very varying proportion of those elements themselves; but in the organic kingdom we have only four elements to deal with—carbon, hydrogen, nitrogen, and oxygen. As Schiller, in one of his famous songs, says, without referring to this subject, but very appropriately describing it:—

"Vier Elemente innig gesellt
Bilden das Ganze bauen die Welt."

It is owing to the very intimate admixture of those four elements that we have such a variety of organic compounds; and the very fact of their being so numerous implies that there must be an extreme facility of transformation,—that very slightly varying physical causes must be sufficient to produce a constantly varying result, by the transposition of the elements themselves. The substances which in organic nature produce this transformation are generally called "ferments." These ferments are bodies in a state of change, able to pass over their changing character to the organic substances with which they come in contact. Let me take, as an illustration of the nature of these changes, what takes place in the brewing of beer. The first act of the brewer of beer is to convert the barley into malt; that is to say, he allows the grain to germinate, and during the germination the oxygen of the air acts upon one constituent of the grain,—upon the gluten,—and causes it to pass into a state of change. This state of change, under the name of a "ferment," acts upon the starch of the grain, and converts it first into a gum-like substance called "dextrine," and then it makes this dextrine pass into sugar, so that the transforming state of this gluten causes the passage of the starch ultimately into sugar. Now, it is not only the state of change of gluten which produces this. For instance, in South America, where the action of germination in converting starch into sugar is not understood, saliva is used as a substitute. There is a decaying substance in saliva,—a decaying albuminous substance similar in its composition and in its disposition to change to gluten. Beer is made from maize, by old women chewing the maize and giving the ferment of the saliva to it; it is then spit into jars along with the saliva, which causes the complete change of the starch into sugar, and then it is fermented, and the alcoholic fermentation results. In the South Sea Islands beer is made in a similar way. There, only the young men and young women with good teeth are allowed to chew the seeds of the long pepper, and after mastication it is spit into jars, where the albuminous matter of the saliva acts as a ferment and converts the starch into sugar, and, ultimately, it is allowed to ferment by the action of heat; it is partaken of by the king and nobles, and is much esteemed, although, to our palates, it tastes exactly like Gregory's mixture. In these different methods of brewing beer the ferment has acted by passing over its own state of change to another body. The starch was in a state of rest, but this changing body made it act—made its molecules transpose themselves, and the starch became sugar. The second act of the brewer is this: having converted this starch into sugar, he converts that sugar into something else, and for this purpose he takes a new ferment which we know as yeast, and adds it to the sugar. We have taken honey in this experi-

ment, which we know is the easiest to act upon. You see what is now going on. Here the action of this yeast or ferment converts this sugar into alcohol, which remains in the vessel, and into a gas—carbonic acid gas—which is passing over here, and which you see is bubbling up into this jar. That it is carbonic acid may be easily shown by putting an ignited taper into it, and then it will become extinguished. If it is there it will put this out, and you see it puts it out immediately [lowering a lighted taper into a vessel in which some of the gas had been collected]. Now, this gas which is thus produced, and which we shall have occasion to examine again, is a degraded state of the organic matter. In all these changes produced by ferments upon organic bodies the change is a continual degradation. The complex and highly constituted organic molecule is under the influence of these ferments continually changed and continually becoming degraded or becoming simpler, until it is converted into three simple bodies as the final result—carbonic acid, water, and ammonia. If we had time I could let off a little of the contents of this vessel and show you that a spirit remained in the liquid. In this alcoholic fermentation, as it is termed, sugar, which contains thirty-six atoms of carbon, hydrogen, and oxygen, is changed into two simpler bodies—alcohol and carbonic acid. Now, this carbonic acid is so simple that it is not capable of being changed further under the ordinary influence of ferments of this kind; but the alcohol is still complex, and if I allow the alcohol when it is formed to be exposed to the air, putting another ferment into it, it undergoes an alteration. A ferment which is often employed is what is known as the "vinegar plant," and then a change takes place of another character; under the influence of this ferment the oxygen of the air attacks the alcohol and burns it, and it becomes vinegar, or acetic acid. Here is a change of another character produced upon it: still a degradation of the original substance.

I want you to notice what I said last, because it is very important. Upon a complex molecule being acted upon by air there was a burning of the body,—a complete combustion of the body. I will show you that action here. Here is some oxygen, and I want to show you that a quick combustion and a slow combustion are in reality the same in regard to their chemical results. I have here—and will produce a quick combustion by it—some charcoal. Now, I heat this charcoal to get the surface ignited, so that it will have a tendency to unite with the oxygen of the air. There is already a quick combustion now going on in the air, in the chemist's sense of the term, but it will be more rapid if I place it in oxygen. You see now under the influence of this oxygen there is a more rapid combustion going on. The carbon is uniting with that oxygen, and it is producing the same substance exactly as was obtained by the fermentation.

And now I want to ask your attention to the fact, that combustion may be very slow and yet produce exactly the same gases. Here I have an experiment of a very simple character which will show you this. This tube contains moistened sawdust. Now, I can draw air through this sawdust by a very simple contrivance,—by allowing the water to run out of this vessel or aspirator which is attached to this end of the tube containing the sawdust; and I allow air to pass into the other end of the tube, and the air therefore passes through the sawdust. In this case it is acting on the sawdust and burning it, exactly as it is burning this charcoal. What I want to show you is, that the results in these cases are the same,—that carbonic acid is produced in the one case as shown by the lime-water which has become turbid, just as now I will show you that carbonic acid is produced here by its also rendering lime-water turbid. I have here a little lime-water, and I add it to the vessel in which we burned the charcoal; and if I shake it, you see that it becomes turbid from this carbonic acid, just as that will become turbid as the gas from the sawdust passes through this bottle of lime-water. Carbonic acid is produced in both cases. Now, if I pass a little hydrogen along with the oxygen of the air, the hydrogen is also converted into water under the burning action which takes place. Now, let me draw your attention to this. I take a lighted taper, such as I have here, and I place another taper in it. The combustion of the one is communicated to the other, and the other taper becomes lighted. This is an experiment which we often perform. Precisely the same action is taking place in this case. The combustion which takes place in that sawdust with the oxygen of the air is forcing the hydrogen which was mixed with the air, before it was passed into the tube, to unite with the oxygen and produce water. The combustion has passed over to it precisely in the same way as in the lighting of a candle, only the result is slower. The fact that the hydrogen has united with the oxygen is shown to you in the experiment by the rise of the coloured water in the glass tube. No condensation takes place when oxygen unites with carbon: the contraction which you observe here is due to the union of hydrogen with oxygen.

I now wish to make an application of these results to the general subject of decay and putrescence.

Organic substances gradually change under the influence of the air, and gradually disappear. You will recollect that about 2000 years ago, when Julius Cæsar made his invasion of England, he describes this country as covered with extensive forests, with large swamps, and moors. Where are all these gone to now? Of these extensive forests not even a piece of fossil wood indicates their existence. All the organic matters of which those forests, swamps, and moors were composed, have disappeared with the bodies of the skin-clad and woad-painted savages who inhabited the forests. They have disappeared under the influence of the oxygen of the air, which has converted all the substances of which they consisted into carbonic acid, water, and ammonia,—the three substances which, as I shall afterwards explain to you, form the food of plants. Chemists now call this process of decay by rather a learned term,—by the term *eremacausis*, meaning "burning by degrees." Before this final decay, or eremacausis, of bodies takes place, there are a number of intermediate products formed, far more dangerous in respect to public health than anything resulting from the process of decay. These intermediate bodies depend in their character upon the nature of the ferment to which they are subjected. Even when the results of the fermentation are the same in kind, a mere difference in degree with regard to the nature of the ferment, or the temperature under which the decay is taking place, or the action of the atmosphere—its greater or less dampness,—causes a very great variation in the intermediate products before the final one is formed. Take a case in which you will see the result of a change in the character of these ferments. For instance, the virus from cow-pox produces, when introduced into the blood of an animal, the result of mild vaccination; whereas the same virus from small-pox produces a malignant disease, although the character of the fermentation is the same in both cases. The intermediate products which result are infinite in their number. They are continually changing, and they form a very large number of bodies, not by what we term the process of decay, but the process of putrefaction. The process of putrefaction consists in the elements re-arranging themselves so as continually to become more degraded. A highly complex molecule, such as the flesh of an animal, under the influence of putrescence continually changes, and gradually assumes more and more simple forms, until finally, as I shall afterwards explain to you, the products become, under the influence of decay, of extreme simplicity.

You may desire to know what is our evidence that the air during all these changes, which every organic body must experience, contains such impurities—bodies in the state of transition before they have been finally

decayed. Well, the process by which this may be shown is a very easy one, and one by which you may easily satisfy yourselves. Suppose I had a large glass globe like this, filled with ice. The dew of the apartment condenses upon the outside of the globe, and may be collected. It brings down with it in solution those substances which abound in the atmosphere, and of which a large quantity can always be obtained in a lecture-room, such as this, if we desire it. Many of these matters are in a transition state; and when you collect this dew, it in a very short time becomes putrid and has a very bad odour, because it has brought down these aërial substances which are in a transition state. In Russia, for instance, where the extreme cold in winter causes the moisture of the apartments of the peasants' houses to become condensed and frozen, a large quantity of these organic emanations are condensed and are preserved until the thaw in spring causes them to melt, and then they are again diffused through the air, and so produce those disagreeable odours which are so well known in the houses of the Russian peasantry. But it is possible to show the presence of these organic matters in the air by a very simple test, for which we are indebted to Dr. Angus Smith, of Manchester. Until lately we could not measure the amount of these emanations in the air, but it is now a matter of the greatest ease. Here is the whole apparatus required. Suppose I want to measure how much impurities there are in the air of this room, I first get the air of the apartment into this vessel by a very simple operation. I take a bellows which acts in the reverse way from what a bellows usually does, and I pump out by this operation the air from the bottle, which is of a specified size, and then I allow the air of the apartment to enter the bottle. I have now got the air of the room into the bottle. I am now to ascertain what impurities are in that quantity of air, and I do that by taking a weak solution of permanganate of potash—a body which I shall have to allude to, under the head of "disinfectants," more particularly. This is made of a certain strength, which is done by adding to it a known quantity of oxalic acid until it ceases to lose colour.

If I want to know how much organic matter there is in the air, I have only to add some of this solution of permanganate of potash until the colour ceases to be taken away. I add it by means of this measure. After I add a certain quantity I shake it up, to see whether it begins to decolorise, and then add more until the colour ceases to be discharged. I might show you the decolorisation in a much greater degree by breathing into the bottle—introducing organic impurities intentionally. I dare say I can decolorise a sufficient quantity to show you at a distance. We will allow it to stand a little, and this will gradually become decolorised until I take away all the colour from it. In this way I can measure the relative amount of organic matter which is present in the atmosphere. Now I wish to refer you to this table, and you will see how various the amount of impurities is in different localities. The numbers represent the graduations upon this measure.

Organic Matter in Air.

Hospice St. Bernard	2·4
German Ocean	2·5
Pig-stye	94·0
Centre of Manchester	52·0
Ditto to outskirts	44·0, 40·0, 42·0, 38·0, 36·0, 30·0, 27·15, 19·0, 16 0, 12·0
Calton Hill, Edinburgh	12·0
Princes Street	22·0
Cowgate	40·0
High Street	30·0

Air taken from the Hospice St. Bernard required only two and four-tenth measures of this instrument to be added to it before the colour ceased to be discharged. Air taken from the German Ocean required just about the same, so that we may suppose that this proportion gives us good and pure air. But look what a pig-stye requires! The air taken from the top of a pig-stye required ninety-four of these measures before the colour ceased to be used up. As soon as the colour remains you know that all the organic matter is destroyed, because it is the oxygen in this permanganate of potash which burns up and destroys the organic matter. See how the amount varies from the centre of Manchester to the outskirts. In the centre of Manchester it requires 44 measures; as you go out towards the country it requires only 40, then 38, 36, 30, 27, and so on decreasing until you reach the outskirts, where it requires only 12 measures; showing that the amount of aërial impurities in a large town varies in the different parts. At the top of Calton Hill it requires 12 measures. You will remember that this is in the centre of Edinburgh; but as soon as you get down into Princes Street the number is increased to 22. Then there is the well-known Cowgate, where it requires 40 measures; and the High Street, which is a little better, where it requires 30 measures of this solution. This instrument enables you to find out, with the greatest ease, the amount of organic matter or other deoxidisers, such as sulphurous acid, which are present in various atmospheres.

The organic substances which are indicated by this air test, are those which are in their intermediate state—a state of putrescence; and it is after this stage that the air manages to purify itself by converting these intermediate bodies into the simpler form of bodies which arise from decay.

Now, before we can understand in what way the air purifies itself, and how we must imitate Nature in obtaining substances to do as the air does, I must draw your attention to the different states of oxygen. Oxygen, as you are aware, forms nearly one-third of the atmosphere which surrounds the globe; it exists in two states, in one of which it is a very active body, capable of uniting with a great many substances, and more decided in its affinities than the ordinary oxygen of the atmosphere. When we treated of phosphorus in the last lecture, I showed you that there were two kinds of phosphorus,—one of these was waxy and yellow, the other was like a piece of brick, and I described to you that they were different allotropic conditions of the same element; and exactly in the same way we have two allotropic conditions of oxygen, one of which is an extremely active body—far more active than the oxygen as it is ordinarily produced. We have had here two sticks of phosphorus in air, and these sticks of phosphorus polarise the oxygen which is present, breaks it up into two conditions, one of which is ozone, which is a very active body, and the other, which I shall explain to you, has been termed "antozone," that is also in an active state. The influence of this process is to polarise the oxygen, and break it up into two states, the two together forming common oxygen; at least, that is the theory which is most explicable, and then we obtain the air in a very peculiar condition.

Before I show you this, I should like to explain to you the meaning of the test which I am going to use. Here we have a weak solution of iodide of potassium and starch; if I add anything to liberate the iodine, the starch will become blue; I can do that by adding a little chlorine; here we have a bottle of chlorine, which I will simply open over it, and blow into it. Now look what is resulting. The chlorine liberates the iodine, unites with the starch, and produces that beautiful blue colour. Now, this ozone has the same property as this very active body—chlorine—has, and if I take a piece of paper moistened with the solution of starch and iodide of potassium, you see what the chlorine does to our paper. Here I take another piece of this paper, which has not been under the influence of chlorine, and I moisten it, and then I introduce it into this bottle, which contained phosphorus. You see exactly the same results as with the chlorine; I have got here starch-paper with a

little iodide of potassium upon it, and introduce it into the oxygen; now the mere influence of the presence of the phosphorus has been so great that it causes the oxygen to liberate the iodine, and produces this action on the paper. This ozone is one of the great scavengers of nature; it is its presence in the air which causes these putrescent bodies to burn and pass from their intermediate state of putrescence, in which they are very dangerous, and which produce, if they act upon the blood, many diseases. This active form of the oxygen causes such bodies to be burned.

I have now to call your attention to the thing called "antozone." Whenever any state of oxidation takes place, and the body ozone is produced and unites with any body, antozone, which is its companion, or other polar state of oxygen, is also produced. I will try to show you this by a very delicate operation, which I may not succeed in. Here we have upon the funnel some common zinc, and I am going to oxidise that common zinc by moistening it with water, so that I do not cover it completely, but still allow it to be in contact with air. Now this water I must return several times, and whilst this is being done I will show you what are the tests for this other form of oxygen, or this antozone, which is also produced in common cases of oxidation. Whilst the ozone unites with the zinc, I hope to be able to prove to you also that there is antozone, or this other form of oxygen. Now let me show you what is the test for this antozone. Antozone, the other allotropic condition of oxygen, is soluble in water, and it forms with the water a solution which we know as the remarkable body—peroxide of hydrogen. Here is some of this peroxide of hydrogen ready formed, and I add to it first distilled water, and then a solution of starch, and iodide of potassium. Now, nothing takes place when I add that, because antozone has not the power,—is not strong enough to liberate the iodine. If I convert it into ozone by a peculiar action, by putting sulphate of iron upon it, the sulphate of iron having no action upon iodine, you see that a deep blue results, because I have converted this antozone into ozone, and the ozone has produced the blue colour by liberating the iodine upon the starch. Now, with that knowledge before us, let us return to our zinc experiment. The ozone having joined the zinc, its companion, antozone, ought to be found in the water. We will just see whether we can detect it in the water, if not we must pass it through three or four times, and ultimately it will be present. Now, I apply some of this test, iodide of potassium, and I will add a little of the test, sulphate of iron. It becomes a deep blue. Look what a beautiful experiment this is; the oxidation of the zinc in presence of air and water has liberated one of the conditions of polarised oxygen. One form of the oxygen is found in the water, which now contains peroxide of hydrogen. But now I want to try another experiment, which is still more delicate, and with which I will not promise success, but we will do our best to ensure it. I want to show you ozone in the air and antozone in the water. I will show you that by adding a little ether, and shaking this ether up with water. We will heat this piece of platinum over gas and plunge it into this ether, first allowing it to cool sufficiently, so that it may not set the ether on fire. Now I am producing ozone in the air of the bottle; but I want to show you, if I can, that I have also antozone in the water. I can show you both perhaps, showing that the common oxygen of the air is gradually formed into ozone, and that its companion, the antozone, exists in the water. Now we will try it; perhaps I have not got enough yet. We will now put this starch-paper in, and see whether we can detect any ozone present in the air. I find that it is there abundantly. There is proof that our ozone, at all events, is present in that air. There is the blue colour produced by this action, so that I have got ozone in the air. Now let us try whether we can find any antozone in the water. In this case I will apply the chromic acid and ether test so as to prevent confusion. If there is sufficient peroxide of hydrogen produced, if we have waited long enough, you will see a very beautiful polarisation,—not only that we have got ozone, but that its companion antozone also comes. You observe how beautifully the deep blue appears as a solution in ether. Now, in this case we had a complete polarisation of the oxygen; the oxygen separated into two forms, both of them very active,—one as it exists in peroxide of hydrogen, and the other as it exists in ozone. Now, this constantly occurs in the atmosphere. Whenever any organic substance is oxidised in the air it polarises the oxygen, and causes the air to oxidise it, and get rid of the body from the air.

Having explained these elementary points, I will show you their application to the process of disinfecting or deodorizing. Our knowledge of these has extended considerably within the last ten years, and the subject is well worthy of our attention. Let us, first, get rid of the term "deodorizers," and fix our attention on disinfectants. The word "deodorizer" is a more agreeable one to polite ears than the word "disinfectant," and we had better define them both. A *deodorizer* is something used to mask a smell without destroying it. A *disinfectant* is something which either prevents the smell or destroys it when it exists. When we read that in ancient Capua whole streets were devoted to perfumers' shops, the conclusion is obvious that ancient Capua was a very dirty place, and that these perfumes were used to conceal its smell. I allude now only to perfumes used to mask that which is disagreeable, and not to their use as a luxury; for from the time that Moses was commanded to offer a perfume on the golden altar until now, the odour of perfumes has been grateful to man. Only in a very modified sense are perfumes true disinfecters. Perhaps I can best illustrate my meaning by two quotations from the "Odyssey," which will explain to you what a deodorizer is and what a disinfectant is. You recollect that when Eidothea aided Menelaus and his three companions to circumvent her father, the old sea-god, she flayed four seals and dressed them in their hides, so that the sea-god might mistake them for part of his sea-flock. Menelaus, however, groans under the disguise of these odorous garments as follows:—

> "Dire was the ambush and the stench severe.
> Who could a rank sea-beast at such close quarters bear?
> But she delivering us a great help planned,
> And placed Ambrosia near the lips of each,
> Which in our nostrils breathed an odour bland,
> And the sea-monster's stench did overreach."

It is clear that Eidothea was a deodorizer. She did not understand disinfection. Ulysses, however, did; for after his terrible slaughter of the many suitors of Penelope, he used an excellent disinfectant. We read,—

> "'Bring sulphur straight, and fire,' the monarch cries.
> She hears, and at the word obedient flies.
> With fire and sulphur, cure of noxious fumes,
> He purged the walls and blood-polluted rooms."

In this case sulphurous acid was produced, and it is an effectual disinfectant. It causes the liberation of ozone by uniting with antozone, and the former battles with the putrid odours and destroys them.

Now, when we consider disinfectants, we divide them into two classes: first, those substances which act as ozone does—by destroying, or burning, or oxidising the organic matter, which is the way in which ozone acts; and second, those which act by preventing putridity, or preventing putrefaction taking place, do not allow decay to go on.

We will take the first action. I will illustrate this by the action of the soil on putrid matter. When you bury a putrid piece of meat in the soil the smell disappears, but the piece of putrid meat disappears also. The porous character of the soil conducts oxygen to the substance, and burns the smell, but the piece of meat gradually is burnt away also and wholly disappears. I think I can show you this action experimentally. I am now going to burn a body which is very difficult of combustion, but which, under the circumstances, I think

I shall be able to succeed in burning. I have here some ammonia, which is always one of the products of the change of organic matters which contain nitrogen, and I am going to pass this body over oxygen under conditions in which I can get oxygen condensed. This is spongy platinum, and I think I can thus show you that the oxygen which is condensed in that platinum will unite with the body I wish to burn, just as the oxygen which is condensed in the porous soil. Now, oxygen is passing over from this receiver, and ammonia from this vessel; and these two, acting together, will cause a burning or the formation of nitric acid and nitrate of ammonia, which you will observe by the fumes which will take place. You already see the fumes, but you will observe the action more distinctly presently. Look how abundantly the fumes are being produced there from oxidation. You see it is now going on so fast that the platinum becomes red hot. You see there how beautifully the oxygen is burning that ammonia—converting it into nitric acid and nitrate of ammonia, and completing the combustion. Those disinfectants which act in this way,—either by means of porosity or by their chemical character,—are bodies acting exactly as ozone does. Now, here is a very common disinfectant, and a very interesting one. Charcoal also has the power of condensing gases within its pores. If I take a piece of charcoal and heat it, it will absorb this ammonia gas. Here I have the means of applying this charcoal disinfecter in various ways devised by Dr. Stenhouse, and which form a complete example of the disinfecting character of a soil which absorbs oxygen and then passes it over to other substances. These different forms of application on the table are cases which may be filled with this porous substance—charcoal. When this perforated box, for example, is filled with charcoal and used as a filter for air, the organic matter in the air which passes through is brought into contact with this charcoal and becomes consumed, just as the fuel of a fire is consumed, and is converted into carbonic acid, water, and ammonia. Supposing you take a dead animal —a dead cat or a dead pigeon—you may make a grave for it of charcoal and keep it for a length of time. You must not suppose that it is not decomposing because there is no odour from it. You might as well deny that there were fires in a house because you do not see any smoke coming from the chimneys. If the combustion is perfect, inodorous invisible gases escape in both cases. In the case of this decomposition, the oxygen absorbed by the charcoal burns the organic matter completely, and prevents a smell. This circumstance has been applied to various purposes, such as filters and respirators. Here are various examples of them. Here is a respirator used for respiration in infected or badly ventilated places, or for removing the effects of foul breath in disease. Here are ventilators of various kinds to filter out effluvia from air before it enters our habitations.

The next disinfectant to which I shall direct your attention, which acts by burning up the noxious organic matter, is "Condy's disinfecting fluid," which is no doubt familiar to you. There are various samples of it which Mr. Condy has been good enough to send me, and which you may examine after the lecture. They are all compounds containing manganic acid, or permanganic acid. Manganic acid is a substance consisting of two equivalents of manganese and six of oxygen. In permanganic acid there are seven equivalents of oxygen and two of manganese. Both of these acids give over their oxygen readily to organic bodies, and in this way act as true disinfectants by burning them or destroying them. Look at the bottle into which I breathed some time since, the colour is nearly destroyed, the permanganate of potash which I employed having burnt out the organic matter; and so this substance, if it be used as a disinfectant, destroys the putrid effluvia by giving over its oxygen to it, and burning the organic matter. This can be illustrated. If I allow this fountain to act, the liquid will gradually become totally decolorised, because it burns away the organic matter which is present in the air of the lecture theatre. These permanganates have, in consequence of this property, become familiarly and extensively useful; but these are local disinfectants, and necessarily local disinfectants, although we try to increase their surface by moistening a cloth, and hanging it in the air. When we desire, however, to disinfect a whole room or the wards of an hospital, we must resort to some gaseous compound which can diffuse itself throughout the air, and combat the enemy in every inaccessible nook and corner, as is the case with the sulphurous acid which was employed by Ulysses. Perhaps the most effective of these gaseous oxidising disinfectants is nitrous acid. It was for this that in 1802 Parliament gave a reward to Dr. Carmichael Smith. In contact with the air, it forms nitrous fumes. Now, these nitrous fumes form an excellent disinfectant, but they are irritating to the lungs just as chlorine is. It may appear odd to those who know sulphurous acid gas chiefly in its character of an absorber of oxygen, that I should allude to it as an oxidising disinfectant; but, according to Schönbein, in the act of taking one portion of oxygen to itself, it converts another portion into ozone, which produces the disinfecting result.

The other class of disinfectants of which I have spoken are the non-oxidising, and I must allude to these very shortly. Their action is to prevent putrefaction by arresting it in a singular way without destroying the organic matter, and they do not allow the decay to go on. The most useful of this character of bodies is a mixture of sulphite and carbolate of lime—sulphurous acid united with lime—and carbolic acid united with lime. It is better known under the name of "McDougall's disinfecting powder." Now, in this case the carbolic acid prevents any decay. As an illustration of the preservative action of carbolic acid, I have on the table sheep-skins sent from Australia preserved by this means; they have simply been washed over with carbolic acid. When the disinfecting powder is applied liberally to organic matter, it arrests wholly the change. On one occasion, I preserved a human body for two months in this way until it reached a distant grave. If the mixed sulphite and carbolate of lime be applied only to a small extent, the carbolic acid prevents putrefaction, whilst the sulphurous acid acting in the manner I have explained, by uniting with antozone and liberating ozone, becomes a true decayer, and allows decay to progress.

But, as the hour goes on, I have been hurried a good deal in this latter part of my subject, and I must now sum up generally the manner in which Nature acts in keeping our air perfectly pure. I will draw your attention to the fact that plants derive their food from the ultimate products of the decay of animals. Carbonic acid, water, and ammonia are the food of plants—simple forms of matter, which they take and mould into the complex organic forms of which the substance of plants consists. Animals feed upon these plants. Animals have not the power of producing complex organic matter out of unlike matter such as the simple inorganic forms of water, carbonic acid, and ammonia. They receive their nutriment from plants, and the whole act of their lives is to take those highly organised forms produced by plants, and convert them again into the simple conditions of carbonic acid, water, and ammonia, from which the plants derive their food. Look what a machine an animal is: how closely he resembles a steam-engine! A steam-engine in action takes fuel, which is its food, consisting of coal and wood, which are decayed vegetable combustible matter. An animal takes recent vegetable or animal combustible matter. A steam-engine takes in water, and so does an animal. A steam-engine breathes air, and so does an animal. A steam-engine produces, by the combustion of the air upon the fuel, a steady boiling heat of 212° by quick combustion; and the animal produces a steady

animal heat of 98° by slow combustion. The steam-engine produces smoke from the chimney,—that is, air loaded with carbonic acid and vapour. An animal produces foul breath from the windpipe, which is air loaded with carbonic acid and vapour. The steam-engine produces also ashes, which is a part of the fuel which does not burn; and the animal produces refuse, which is a part of the food passing from the body unconsumed. The engine produces motive force or alternate push and pull in the piston, which acting through levers, joints, and bands, does varied work. The animal gives rise to motive force by alternate relaxation and contraction of the muscles, which acting through levers, joints, and tendons, does varied work; that is to say, an animal is, in all its chemical functions, a machine, which is producing certain results by combustion; and it takes these complex vegetable and animal combustible substances, and gives them out in a simpler form.

Now see how different animals are from vegetables in a chemical sense. Here is a table showing their differences and dependencies:—

Differences and Dependencies of Animals and Vegetables.

A VEGETABLE	AN ANIMAL
Is an apparatus of reduction.	Is an apparatus of oxidation.
Is fixed.	Possesses the faculty of locomotion.
Evolves oxygen.	Absorbs oxygen.
Absorbs heat and electricity.	Evolves heat and electricity.
Decomposes carbonic acid	Produces carbonic acid.
Ditto water.	Ditto water.
Ditto ammonia.	Ditto ammonia.
Produces organic substances.	Consumes organic substances
Transforms inorganic matters into organic matters.	Transforms organic matters into inorganic matters.
Derives its elements from the earth and air.	Restores its elements to the earth and air.

They are perfectly antithetical in their actions. They are always opposing each other, but without antagonism; they are rather co-ordinates, one acting in harmony with the other. The vegetable is constantly producing organic forms from the air, while the animal is converting these same materials back again into inorganic forms. There is always in this way a constant co-ordination between the two. The animal is able by its respiration to produce a certain quantity of carbonic acid, water, and ammonia; but after the death of the animal there remains a considerable quantity of matter which requires to pass into the state of carbonic acid, water, and ammonia. It passes into that state by putrescence, and afterwards by decay. Decay starts the putrescence; decay finishes the putrescence by converting the animal matter into those substances,—carbonic acid, water, and ammonia. The animal stands midway between the vegetable and mineral kingdoms. It is not his duty to mould mineral matter into organic forms. That is the work of vegetables, whose highest function is their vegetable growth. Animals with the demands of volition to obey cannot spare their force in this conversion. As chemical machines, animals are constantly undoing what vegetables have done. During life animals are continually reconverting organic substances into simple inorganic forms, and after death their bodies pass into the same substances. Thus there is alternate life and death. It is quite true that plants feed animals; but animals, in an equally true sense, feed plants. They furnish the carbonic acid, water, and ammonia of which the plant consists, and the death of one generation is absolutely necessary to the life of successive generations, giving the very materials out of which the next is built. Life is the consequence of death. Nature uses up her waste materials for the perpetuity of life. In all cases we are feeding upon our ancestors. The transmigration of souls is not true; the transmigration of matter is perfectly true. I do not know of how many millions of atoms of transformed matter my brain consists. A portion of the constituents of my brain may at one time have performed its part in the functions of the liver of an extinct King of Dahomey, babbled in the tongue of an Asiatic parrot, or danced a fandango in the legs of a Spanish South American. Thus, continually we observe that Nature uses up her waste materials by beautiful processes which we try to imitate in our hygienic measures, and produces out of them substances which become of great utility in the economy of the universe. In several of my lectures I have endeavoured to bring before you the economy of chemistry. I have shown you that it takes substances apparently repulsive, and converts them into industrial utilities. We only imitate Nature in this respect. She allows nothing to be wasted in the universe, but always converts the refuse materials into substances useful to man. When you see Nature thus cherishing her waste materials, and carefully using up all effete, decaying, and putrid matter for great purposes in the economy of the universe, you will not be inclined to think that the economy of chemistry in converting waste substances into industrial utilities, is either ignoble or repulsive, or that the subject itself was unworthy of being brought before you.

In taking my leave of you, I think that there is an apology which I ought to make, and it is this: when I undertook this course of lectures, I did so at a time when I thought I was coming to London as a visitor to see the International Exhibition, but when I came here I was enlisted into very heavy work, having the charge of the juries of the Great Exhibition. Feeling that I could not associate the two engagements with advantage, I endeavoured to get off my appointment here, but my friend, the Secretary, would not consent to that step. (Applause.) If, therefore, there have been many shortcomings in these lectures, you must excuse them upon the ground that I have delivered them under great difficulties. (Applause.)

CORRESPONDENCE.

On the Detection of Strychnia.

To the Editor of the Chemical News.

Sir,—In a matter of dispute with any gentleman on a subject, I am prepared for a fair discussion upon the merits of what has been advanced; but since the publication of Mr. Rodger's remarks in his last letter, I must decline any further correspondence thereon.

The value of the test proposed is not in the least diminished, and in the purest state nitro-prusside of sodium furnishes us with an excellent means of collecting strychnia from its solutions,—a drop or two of the reagent added to strychnia liquor producing an abundant precipitate of nitro-prusside, which of itself is a reaction, to say nothing of the effect of other reagents upon it.

In reference to Mr. Rodger's statement as to the detection of $\frac{1}{100000}$th or more of a grain by bichromate of potash and sulphuric acid, having repeatedly tried it without success, I should in a criminal prosecution be very indisposed to rely on that method for so small or even a larger quantity of strychnia.—I am, &c.

John Horsley, F.C.S.

The Juries' Bill.—The Clause of the Juries' Bill which exempts pharmaceutical chemists from serving on juries has now passed the House of Commons, and before these lines reach our readers will have become the law of the land. "Next year," said Sir George Grey, "the whole body of chemists and druggists will be claiming the same exemption." No doubt of it; and one of the first things to decide will be "who is to be considered a chemist and druggist." Those of our readers who do not happen to be pharmaceutical chemists should bestir themselves early.

ANSWERS TO CORRESPONDENTS.

Several communications in type are unavoidably postponed.

THE CHEMICAL NEWS.

VOL. VI. No. 141.—August 16, 1862.

THE BRITISH PHARMACOPŒIA AND ITS WEIGHTS.

IT has been urged rather by way of apology than defence, that after all the subtraction of $\frac{1}{11}$th from the weight of the grain is a matter of small importance in pharmacy; that supposing a medical man of the present generation to take the change into consideration when writing a prescription—a rather extravagant supposition—and the dispenser afterwards to compound the medicine by the old weights, the addition to the dose, even if one ingredient were strychnia, would be attended with no risk to the patient. We do not admit this; but if it were true, it would by no means justify the alteration. If the old weights could be at once discarded, the case might be different. But, as a matter of course, all prescriptions written before the Pharmacopœia is published must be compounded by the old weights, and for that reason the pharmaceutist or apothecary must retain these weights in use or constantly occupy his mind with arithmetical problems which will never lead to a perfectly accurate result.

The time which must elapse before a change of the proposed kind is fully established in common use the Medical Council have probably never considered. We can help them to some materials for forming a conjecture on the subject. The imperial pint was first introduced into pharmacy in the London Pharmacopœia of 1836; but there are yet many medical men who prescribe a pint and mean *sixteen ounces*. Avoirdupois weight was introduced into the Dublin Pharmacopœia of 1850, nearly twelve years ago; and yet an eminent Irish physician has recently expressed to us his belief that if the question, "How much is a scruple?" were put to all the medical men in Ireland, not a quarter of them could answer it correctly without a reference. There is some excuse for this ignorance, because, inasmuch as the Irish College did not meddle with the grain weight, the Irish scruple consists of 18·229166 standard grains,—a difficult number to get into a head which had always before understood that twenty grains made a scruple.

We quote these illustrations merely to show how long it takes to establish a new measure and weight in general use; and if the change now proposed be really introduced into the Pharmacopœia, we have no doubt that for the next twenty years whenever grains are prescribed it will always be a question with a pharmaceutist, "which grain?" unless the prescriber takes the trouble to write the word new or old before grain.

But it is not merely in pharmacy that confusion will be created. The unfortunate medical practitioner will be beset with perplexities on every side. He will have two grains: one he will prescribe by and mix his physic with, but when he comes to read any scientific work he may find a different grain in use, and if the work be medical or physiological he will always be in doubt which grain is meant. If it is chemical he may rest assured that it will be the standard grain, for scientific chemists are not likely to change their weights according to the caprice of the Medical Council. Some day or other—perhaps before many years are past—our entire system of weights and measures must undergo revision, and of course pharmaceutical weights will participate. In the mean time, we protest against a change which only makes "confusion worse confounded," and for one inconvenience which it remedies introduces at least three new difficulties.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Two New Colouring Matters Resulting from the Oxidation of Phenic Acid, by M. FRED. FOL.

I HAVE been led to the discovery of this colouring matter by the results of a series of experiments undertaken for the purpose of studying the action of bisulphate of mercury and other bisulphates on aniline and the other compounds of phenyle. Bisulphate of mercury producing, under rather singular circumstances, a red similar to fuchsine, I hoped to arrive at the same result by combining the action of bisulphate of mercury and other bodies on phenic acid. In place of what I sought for I obtained a reddish-brown resinous matter, yielding, with alkalies, very soft red and rose colours, and by itself dyeing yellow. The reaction, with heat, of bisulphate of mercury on phenic acid, disengages too much sulphurous acid; I was therefore constrained to set aside this reagent, which destroyed, in proportion to its abundance, the colouring matter produced. Seeing that it was a case of simple oxidation, and not wishing to introduce nitrogenised bodies, I tried dried arsenic acid; and this is the way the operation may be economically conducted:—

A mixture of five kilogrammes of phenic or cresylic acid, or other analogous substances, with three kilogrammes of dried and finely powdered arsenic acid, is heated for twelve hours at 100° C. in an iron caldron. Stir the mixture frequently with an iron spatula. The coloration appears at the end of about two hours, and increases gradually in intensity as the mixture thickens, with disengagement of aqueous vapour. At the end of the twelve hours raise the temperature to 125° C., and maintain it at this point for six hours; the mixture, at first slightly puffy, becomes pasty and quiet; when all action has ceased, the smell of phenic acid will have totally disappeared. Then add ten kilogrammes of commercial acetic acid at 7°, and heat till the whole is completely dissolved; an excessively dark liquid results; decant this, and exhaust the residue in a caldron with two litres of acetic acid; filter these acetic liquids, which contain a yellow colouring matter, through cloth.

To extract this matter, dilute the liquid with twelve

litres of water, and saturate it with chloride of sodium. The colouring matter then precipitates itself under the form of flakes, which, collected on a cloth, are of a pale brown colour. Redissolve the precipitate in water, refilter it, and reprecipitate it by chloride of sodium, when it may be considered sufficiently pure. Spread upon porcelain plates on a stove, it quickly dries under the form of brilliantly coloured reddish-brown spangles.

The colouring matter dissolves in considerable quantities in cold water, the solution being golden yellow; it is much more soluble in boiling water, from which, on cooling, it deposits reddish-brown plates; it is soluble in alcohol, methylene, and ether; insoluble in benzol; soluble, without alteration, in all acids. Cold concentrated sulphuric acid dissolves it; the addition of water causes no alteration in the solution, and the colouring matter loses none of its primitive qualities. Concentrated or dilute alkaline solutions, alkaline, and earthy carbonates, easily dissolve the colouring matter, forming red salts, which die silk and wool perfectly, from the darkest red to the most delicate rose colour.

The solubility of the baryta salt suggests a new way of purifying this colouring matter. By dissolving it in boiling water with twice its weight of freshly precipitated carbonate of baryta, the impurities attach themselves to the excess of carbonate, and the filtered boiling liquid, saturated exactly with sulphuric acid, again filtered, and saturated with chloride of sodium, furnished the colouring matter in an extremely pure state. This pure colouring matter is yellow; it is an acid forming red salts; the circumstances under which it is formed are analogous to those under which picric acid is formed. One is the result of oxidation by nitric acid, the other of oxidation by arsenic acid. In each case we have a yellow acid and coloured salts; and the two acids dye yellow without a mordant.

Soap has no effect on wools and silks dyed yellow with this acid; the red tint is made very brilliant by soap. It is very possible that this new substance can be used in printing.

This colouring matter is not identical with that discovered by MM. Kolbe and Schmidt, though the two bodies have some points in common. For this reason I have felt no hesitation in publishing my researches, without any intention of decrying the substance described by MM. Kolbe and Schmidt.

In a future paper I shall give more complete details of the properties of this substance, which I purpose calling "Xanthophenic acid."—*Répertoire de Chimie.*

TECHNICAL CHEMISTRY.

*Silvering Glass and other Surfaces.**

This invention has for its object improvements in silvering glass and other surfaces. For this purpose I employ a mixture of ammonia, nitrate of silver, with a solution of Rochelle salt (tartrate of potash and soda); this mixture is applied to the surface of glass to be silvered, and after a short time the silver is deposited on the glass as a bright film. The silver is deposited at the ordinary temperature of the air; thus it is not necessary to heat the surface, as when other mixtures are employed. The film of silver may be strengthened by depositing over it a cheaper metal, such as copper. The process above described is also applicable for silvering other surfaces; it is, for example, very useful for giving a metallic and conducting surface to articles on to which it is desired to deposit copper by electricity, and where the article itself is not a conductor of electricity.

In order to silver the surface of paper, or of a woven fabric, or other similar surface, I first deposit the silver on to a polished surface, such as glass; then attach the fabric thereto by suitable cement, and carefully strip the fabric, together with the silver, from the polished surface. In some cases, I obtain an ornamental effect by depositing the silver on a surface on which a pattern has been produced by dulling a portion of the surface.

And in order that my said invention may be most fully understood and readily carried into effect, I will proceed to describe minutely the manner in which I prefer in practice to conduct the processes.

In order to silver a sheet of glass, I place the said sheet, previously washed clean with water, on a table, and rub the whole surface of the sheet with a rubber of cotton or other soft fabric wetted with distilled water, and afterwards with a weak solution of Rochelle salt in distilled water, about one part of salt in 200 parts of water. I then take a solution, previously prepared by adding nitrate of silver to ammonia of commerce; the nitrate of silver being very gradually added until a brown precipitate commences to be produced, and the solution is then filtered.

For each square yard of glass to be silvered, I take as much of the above solution as contains 20 grammes (about 309 grains) of nitrate of silver, and to this I add as much of a solution of Rochelle salt in distilled water as contains 14 grammes of salt, and the strength of this latter solution should be so adjusted to that of the silver solution that the total weight of the mixture of the two in the quantities above mentioned, may be 60 grammes. In a minute or two after the mixture is made it begins to become turbid, and it is then immediately to be poured over the surface of the glass, which has previously been placed on a perfectly horizontal table, but the plate is blocked up at one end, so as to give it an inclination of about one in forty; the liquid is poured on to the plate, along the higher edge, and it runs towards the lower; the pouring is done in such a manner as to distribute the liquid over the whole surface of the plate, without allowing any to escape at the edges. When this is effected, the plate is placed in a horizontal position, at a temperature of about 68° F. The silver will begin to appear in about two minutes. Before the end of ten minutes the plate will be covered, and in thirty minutes sufficient silver will be deposited; this is about two grammes of silver per square yard, which is enough for most purposes. The mixture is then poured off the plate, and the silver it contains is afterwards recovered. The silvered surface of the glass is then washed by pouring water over it four or five times, and the plate is set up to drain and dry. When dry, the silvered surface is varnished by pouring over it (in the same way as the mixture is poured on, as already described) a varnish, composed of the following materials, viz.:—Gum damar, 20 parts; asphalte (bitumen of Judea), 5 parts; gutta-percha, 5 parts; benzine, 75 parts. This varnish dries and sets hard on the surface, and the glass is then ready for framing, or otherwise for use as may be required. When a surface of glass has been silvered as above described, a layer of copper may be deposited over the silver by the ordinary electrotype process or otherwise, as is well understood. I do not, however, prefer to do

* Specification of the Patent granted to John Cimeg, of the county of Middlesex, England, for Improvements in Silvering Glass and other Surfaces.—Dated March 13, 1861.

this when the object is to obtain a silvered glass, but in some cases I deposit a considerable thickness of copper on to the silver, and then strip the copper and silver together from the glass, which will be done with facility when the coating of copper is thick. In this manner a sheet of any size of plated copper may be produced, plates of other non-absorbent materials (which will not act chemically on the silver solution) may be coated with silver in the same manner as plates of glass. When it is desired to give a metallic and conducting surface to an article which it is desired to electrotype, say, for example, a medallion of wax or gutta-percha, I silver it as already described, sufficient of the silvering mixture being employed to cover every part of the surface. In order to silver paper, woven fabrics, and other materials according to my invention, I, as already mentioned, strip the silver from the surface on which it is deposited by attaching to it the paper, woven fabric, or other similar material, and then removing the said material and the silver film together from the surface. The silver is first deposited, by preference, as already described, but it may be otherwise, on to a surface, by preference of glass, then on to the silvered surface is poured in the manner already set out, a varnish consisting of gum lac dissolved in wood spirit, one part of gum lac to from six to ten of wood spirit. When this varnish is dry and hard, a solution of one part of gelatine in from six to ten of water is also poured over, and allowed to set into a jelly; the paper, leather, or woven fabric, or other similar material to be silvered, is laid on and pressed in contact with the jelly, and it is then left to dry thoroughly; afterwards the material with the fabric is stripped from the surface, and the process is complete.

On an Explosive Compound, by John Horsley, *F.C.S.*

If nine parts of well-dried and finely-powdered chlorate of potash be mixed with three parts of finely-powdered galls, a highly explosive compound is formed, which needs no granulation. As it will not admit of trituration in a mortar, the mixture should be made on paper by means of a bone spatula, or by passing it through a fine brass sieve. The strength of common gunpowder may be increased by working up with the powdered meal about twelve per cent. of powdered galls, and re-granulating it. I have been acquainted with this for several years, but never published it before.

An Examination of Pompeian Glass, by M. G. Bontemps.

Window-glass, the utility of which is appreciated chiefly in northern countries, does not seem to have been used in remote antiquity. The silence of ancient Greek and Latin authors on the subject is a sufficient proof that it was unknown in their time; and, in any case, the wonderful expertness evidenced in glass manufacture many years before the Christian era, renders it surprising that no one thought of making glass windows. The first mention of them we find in the first century of the Christian era. Philon, a Jew, in the account of his embassy to the Emperor Caligula, has a passage relating to glass windows. On the other hand, Seneca assures us that glass windows were first adopted in his time. These assertions have long been disputed. Certain commentators argue that these windows were nothing but trellises, or a kind of Venetian blind, made of wood; others maintain that they were made of a fine talc, called *specular stone;* but since the discoveries at Herculaneum and Pompeii, there can no longer be any uncertainty touching this point. The architect Mazois, in his remarkable work on "The Ruins of Pompeii" (Paris, 1814, 1835, four vols. in folio), expresses himself thus (vol. ii. p. 77, chapter on "Public Baths"):—

"If the question of the use of window-glass among the ancients were still doubtful, we should find in this room evidence adequate to resolve it; for here has been preserved for centuries a bronzed sash filled with glass, showing not only the size and thickness of the panes employed, but also the manner of adjusting them. The figures 4 and 5, which give the appearance and the details of the sashes, show that the glass was fitted into a groove, and secured at certain distances by turning buttons, which pressed upon the pane and fixed it. The panes are 20 inches broad (0·54 millimètres), about 28 inches (0·72 millimètres) high, and more than 2 lines (5 to 6 millimètres) thick."

The employment of window-glass at an epoch anterior to the year 79 of our era, the date of the eruptions of Vesuvius which buried Herculaneum and Pompeii being ascertained, glass-workers became much interested in finding out how these panes, which are of considerable size, were made,—whether they were blown into cylinders or plates, or whether they were cast in the same way as a mirror. I could clear up this point only by inspecting the fragments. These panes, which, from their size, could weigh not less than five kilogrammes, if blown could not have been the product of a single lifting of glass; for in this case we ought to be able to distinguish the glass of the different liftings. Were these panes formed by blowing a cylinder, afterwards cut and spread out, the bubbles contained in the glass would be long and parallel with the axis of the cylinder. They would have been concentric if the panes were formed from a globe converted into a plate; and if the panes were moulded the bubbles could have no uniform direction, but would be generally round and flat. Uncertain when I could go and personally examine the fragments of window-glass found at Pompeii, I begged the Minister of Foreign Affairs to ask the Consul of Naples to entrust me with a few of these fragments; and a few weeks afterwards the Minister informed me that the intervention of the Consul M. de Soulanges-Bodin had been successful; that, in fact, the Superintendent-General of the Museums of Naples, M. le Prince de San Giorgio, appreciating the usefulness of my investigations, would be happy to place at my disposal the fragments of window-glass found at Pompeii.

These fragments measured ten centimètres, and after their examination, no doubt could remain of the manner in which the panes were made. The glass was cast free from knots and other imperfections; portions were free from bubbles; while in the other parts these were present in great quantities, but not all caused by fusion. The thickness of the glass was unequal, in some places being five millimètres thick, and in others only three. This sign alone would not show that the panes were not blown. One surface bore the impression of the floor on which it was laid when hot. This might be the mark of the refractory stone on which the cylinder was spread, but the opposite surface did not resemble blown glass. Moreover, there were other indications yet more reliable showing that this glass was not blown. The bubbles were the result neither of a cylinder nor of a globe spread into a plate. It was evident that each pane had been cast; that this casting had not in some parts been carried sufficiently far; and that in others, on the contrary, the workman having reached the limit in this respect,

has returned the glass on itself, and thus led to the interposition of air and the formation of a bed of bubbles. The unequal thickness shows that a metallic cylinder was not used to press upon the glass.

It is, then, probable that a metallic frame of the size of the pane it was desired to obtain—say 0·72 by 0·54 millimètres—was placed on a polished stone, slightly powdered with very fine argil. Into this frame the glass was then poured, taken from the crucible in spoons, probably of bronze, or even with canes, and the glass was pressed with a wooden pallet, so as to make it fill the mould. The ancients then came very near the invention of plate glass, which was not in vogue in France till seventeen centuries later; for they had only to pass a roller over the frames to obtain panes of equal thickness, which would then have required nothing but polishing,—an operation familiar to them; for Pliny, in his "History of the World," says that obsidian was used as mirrors, and it is evident that it must have been previously polished.

The Pompeïan window-glass is of a bluish-green tint, like the common glass fifty years ago. The analysis made for me by M. Fred. Claudet, and of which I can consequently guarantee the exactitude, gave the following result:—

Silica	69·43
Lime	7·24
Soda	17·31
Alumina	3·55
Oxide of iron	1·15
Oxide of manganese	0·39
Oxide of copper	traces
	99·07

This analysis is remarkable, since it coincides exactly with that of the glass now made. In fact, take the analysis of window-glass made by M. Dumas, and we find:—

Silica	68·65
Lime	9·65
Soda	17·70
Alumina	4·00

In the latter analysis, perhaps some traces of iron and manganese have been disregarded; but independently of these two elements, it is to be observed that the two analyses are almost identical.

I ought to state that the glass analysed by M. Dumas was not so good as is now generally made. The window-glass used at present gives on an average the following:—

Silica	72·50
Lime	13·10
Soda	13·00
Alumina	1·00
Oxides of iron and manganese	0·40
	100·00

The Late Jury Awards.—A meeting of the exhibitors dissatisfied with the late awards is to be held for the purpose of considering what steps shall be taken to vindicate their rights.

The Jury Bill.—"There are five towns where I have had, on several occasions, pharmaceutical chemists as jurors. They were so intelligent and so much above the average of jurors in capacity and earnestness to ascertain accurately the facts and the questions on which their conclusions were derived, that I desire to express a regret that pharmaceutical chemists will hereafter have to part company with at least one

"County Court Judge."

INTERNATIONAL EXHIBITION.

Class I.

Mining, Quarrying, Metallurgy, and Mineral Products.

(*Continued from page 75.*)

The case of Mr. Rogers (306) contains an interesting collection of several ores, including some of the German mineral which has lately been brought into great repute by the Messrs. Krupp, and some of the little-used iron-stone from the Devonian system, which may some day become one of our most important sources of the metal. The specimens of sphærosiderite and junkerite will interest the mineralogist. The amorphous carbonate of iron of the oolitic system—the Cleveland ore—is exhibited by Messrs. Bell, of Newcastle (18) and Messrs. Bolckow and Vaughan (31); and the same mineral from Eskdale is shown by Mr. Barnes, of Whitby (11). Since the Exhibition of 1851, this has become one of the most valuable ores of Great Britain. It is scarcely fourteen years since Messrs. Bolckow and Vaughan first satisfied themselves that it was worth smelting, and yet in 1860 the Cleveland district alone produced 248,665 tons of pig iron. The area over which the ore may be worked is said by Mr. Phillips to extend some hundreds of square miles, and the average produce may be estimated at from 20,000 to 50,000 tons per acre. The hydrated oxide from the same geological system is exhibited by the Westbury Iron Company (130), and some of a still later geological deposit by the Hengistbury Mining Company (130). The latter was perhaps the earliest ore worked in England; but later the iron sand of the Wealden furnished our largest supply, and some of the last productions of the Sussex mines are still existing in the railing around St. Paul's. But as the forests of the South became exhausted, and an outcry against the destruction of timber was raised, the manufacture declined, and at the early part of the last century we imported two-thirds of the iron used in England. In 1619, however, the Lord Dudley of that day obtained a patent for smelting iron with pit coal. He shared the fate of many inventors: his works were destroyed by a mob, and his invention was almost forgotten. But the increasing difficulty of obtaining timber called attention to it once more, and then the iron manufacture passed quickly to the coal districts, and to-day we find an Earl of Dudley one of the largest exhibitors of iron in the Exhibition. Too much praise could hardly be bestowed on this collection (332), by Mr. Smith, Lord Dudley's agent, the interest of which, however, will be greater to engineers than chemists. There are many exhibitors of manufactured iron of equal excellence, and we can only recommend our readers to study for themselves the entire display, from the crank shaft of the Minotaur to the "iron-paper" which defies the teeth and digestion of the white ant, and saves the Indian records from destruction. It is a collection of which any nation might be proud.

The tin in the Exhibition calls for no remark. The exhibitors of this metal are necessarily few, and the metal is shown in no variety, but no doubt of great purity.

The display of lead, with its ores and preparations, occupies considerable space, and is well worthy of notice Mr. Sopwith's collection (334) deserves particular attention, exhibiting galena in all stages of preparation for smelting, the lead produced, the beautiful iridescent skimmings from the surface of the melted metal, the silver separated, and the litharge formed. Our lead mines

have now become almost as important a source of silver as of lead, and if England cannot, as Mr. M'Culloch asserted in 1854, boast of silver and gold mines (not exactly true of either metal to-day), we at all events have a perhaps more lasting supply of the former metal in our lead ores. The silver separated from lead ores in the United Kingdom in 1860, Mr. Hunt informs us, amounted to 549,720 ounces. Another interesting case of lead is that of Messrs. Barker, Rawson and Co. (10). These gentlemen exhibit lead in its several stages of preparation, and with its various impurities:—1. "Lead slag," or lead contaminated with antimony, copper, silver, and sulphur; 2. "Softened slag," in which only copper and silver are left; 3. Lead with silver only, and then these two metals separated. The crystalline surface of the pigs of lead, which is said to indicate great purity of metal, is beautifully seen in the specimens here exhibited. In this case the visitor will also see illustrated the plan adopted for obtaining white lead by the old Dutch process. The case of Messrs. Cox and Co. (71) is also to be commended; as is that of Messrs. Shield and Dinning (375), in which some curious small crystals of lead may be seen. In connection with tin and lead we may notice the sanitary pipes made by Messrs. Courage under Bennett's patent (69). These are of lead externally, but have a lining of tin to prevent the action of water on the lead. This is no doubt a valuable invention, if an efficient coating of tin be always applied. The pipes, however, we have seen will not withstand the action of very dilute acids, or a solution of common salt, so the lining of tin is extremely thin, or probably not continuous. It will be necessary to ensure continuity of the surface of tin, or the advantage of the lining will be altogether lost.

(To be continued.)

Jottings from the International Exhibition.

The Jury Award for Thallium.—Those of our readers who were aware that the editor of this paper exhibited specimens of the new element Thallium and several of its compounds in the International Exhibition, Class II., were doubtless, like ourselves, surprised on seeing in the Official Report of the Awards of the Jurors that the only mention of the existence of this body in the building was coupled with an award of a prize medal to M. Lamy, "for the discovery of new and abundant sources" of it. Such a decided transfer of the credit due for the discovery of abundant sources of this element, to say nothing of that belonging to the original discovery, could not for one moment be passed over in silence, and we immediately forwarded a protest to Her Majesty's Commissioners. As this contains several facts which it may be advisable to place on record, we quote it in full:—

TO HER MAJESTY'S COMMISSIONERS FOR THE INTERNATIONAL EXHIBITION OF 1862.

July 14, 1862.

My Lords and Gentlemen,—I appeal to you against a grievous injustice which has been done me by the awards of the Juries, just published. I will state the facts as briefly as possible.

In March and May, 1861, as the result of long-continued investigations on my part, I published, for the first time, the fact of the existence of a new element, to which I gave the name of Thallium, and at the same time described many of its chemical characters, and gave the localities and description of minerals in which it occurred; also stating that I first discovered it in, and prepared it from, some *seleniferous deposits from the chambers of a sulphuric acid manufactory.*

I continued unremittingly to work at the subject, and contributed to the present Exhibition a small case containing several compounds of thallium, the element itself, a drawing of its spectrum, some minerals containing it, and full written descriptions of its chemical properties.

I had nearly completed a detailed paper on Thallium for presentation to the Royal Society, when I heard that M. Lamy had been following in my footsteps, and had just arrived in England with a specimen of thallium. This was on June 9, and I immediately saw the necessity of sending in my paper. It was accordingly read before the Royal Society on June 19.

On June 23 (*four days after me*), M. Lamy read a paper on the same subject before the French Académie des Sciences. In this paper he freely admits that I am the first discoverer, gives dates which show me to have more than twelve months' priority, quotes a considerable part of my original paper on the subject, and adopts my name —*Thallium*. He also says that he found it in some *seleniferous deposits from the chambers of a sulphuric acid manufactory;* that it is from these residues *alone* that he has obtained thallium; and he moreover recommends these residues as the best source for preparing the metal.

In my last paper (published four days before his) I state that thallium is a widely distributed element, and that many commercial products and mineral ores contain it. I also give an easy means of obtaining thallium direct from the ore, and proceed to say that, in some of our chemical works, "thallium is at the present time being thrown away by the hundredweight;" and that "a very slight modification of the present arrangements of the furnaces and condensing flues would enable nearly the whole of this to be saved."

A few weeks ago M. Lamy deposited a specimen of thallium in M. Kuhlmann's case at the Exhibition. On referring to the official report of the awards of medals and honourable mentions, I am astounded to find that my name, or the fact of my specimens of thallium and its compounds having been in the building from its opening, is *not once mentioned*, whilst M. Lamy has a prize medal for "*the discovery of new and abundant sources of thallium.*"

Now, M. Lamy's own paper shows that he has not the remotest claim to this distinction. Not only has he *not* discovered new and abundant sources of thallium, but he has *only* prepared it from the same kind of seleniferous deposit in which I first discovered it. He has pointed out *no* new source whatever for it, whereas I (in my paper published *before* his) give sources and processes by which it can be readily procured in enormous quantities.

This, my Lords and Gentlemen, is what I protest against. I do not ask for a prize, but I do ask for justice. The honour of possessing an Exhibition medal would be insignificant in comparison to that which I have already gained by being the first Englishman, since Sir Humphrey Davy's time, who has discovered a new element; but I feel most keenly the injustice with which I have been treated. M. Lamy has received all the honours of the discovery, whilst I have been quietly snubbed.

In a few years' time these facts and dates connected with the discovery of thallium will be lost sight of, but it will always be looked upon as an incontestable proof of M. Lamy's prior claim, that whereas both he and myself exhibited the metal in the International Exhibition of 1862, the Jury, consisting of the most eminent chemists of all countries, bestowed upon M. Lamy the highest honours it was in their power to give, whilst I was not considered worthy of notice.—I am, &c. William Crookes.

In answer to this we have been informed that a prize medal *was* awarded to us, but, owing to a mistake, it was omitted from the first edition of the published awards. In the second edition it is to stand thus:—

. "William Crookes, medal, thallium, for the discovery of a new element."

The real point at issue is not, however, once hinted at; and under these circumstances, not caring to enter into any further correspondence on the subject, we have thought it the best course to lay the facts as briefly as possible, and without comment, before English chemists.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, April 11, 1862.

John Peter Gassiot, *Esq., F.R.S., Vice-President, in the Chair.*

A Lecture, by A. W. Hofmann, *PhD., L.L.D., F.R.S., President of the Chemical Society, "On Mauve and Magenta."*

The fact of the beautiful colouring matters known by these fanciful terms being substances derived from coal, must, I presume, be familiar to every one of you. But there may be many unacquainted with the means by which this transformation is accomplished. It is to them that I address myself this evening.

Coal to become colour, has to pass through a series of stages of transition, each of which claims our attention for a moment. Briefly expressed, the aim of this address may be said to be, to show you the way from coal to colour. Now let me at once tell you this way is rather long; we may have to travel over country rough and intricate, and now and then to pass through territories which—I confess it with an appeal to the ladies—may not, perhaps, be altogether remarkable for their fragrance and sweetness. But on such occasions we shall accelerate our steps, and, on the whole, I venture to hope that we shall arrive at our journey's end without too much inconvenience.

Colour is intimately associated with light; without light there is no colour. This remark applies in a double sense to the colours derived from coal; for it is to the introduction of gas-light for illuminating our streets and houses, that we are indebted for the acquisition of these colours. This statement may appear strange, for nearly half a century has elapsed during which we have been in the possession of gas, whilst the transformation of coal into colouring matters has been achieved only recently under our own eyes. But you will immediately appreciate the truth of my assertion, if I tell you that these substances are obtained from a secondary product, generated in the manufacture of gas, a product long used for a variety of purposes, but which, only within the last few years, the researches of chemists have proved to be an inexhaustible mine of wealth and interest.

The starting-point then for the production of Mauve and Magenta, is the manufacture of coal-gas; but this is so well known as not to need any detailed description. Let me briefly remind you of the principal features of the distillation of coal, by directing your attention to the two large diagrams representing the "retort house" and the "condensers" of a gas-works. You observe how the coal is heated in stupendous retorts, five or seven of which are generally associated in one furnace. The gas ascends from these retorts in vertical tubes, the bent ends of which dip into a large horizontal pipe, partly filled with water, called the hydraulic main, a considerable amount of the oily and tarry substances generated with the gas being separated by the water. The gas, so far purified, passes on through the condensers—immense vertical iron pipes constantly cooled by a current of cold water which surrounds their external surface. In these condensers an additional quantity of oily matter is separated, which, together with the oily substances deposited by the gas during its passage through the hydraulic main, is collected in appropriately placed cisterns. The gas, having traversed the condensers, passes through a series of further purifications before it is delivered into the mains of our streets; but these, unconnected as they are with our subject, must no longer occupy our attention.

The distillation of coal being the fundamental operation in the manufacture of Mauve and Magenta, it is but fair that it should not remain without an experimental illustration. In this tubulated retort of hard glass, I am heating fragments of coal. The beak of the retort is inserted into a three-necked glass globe, the lower neck of which terminates in a tube communicating with a glass vessel for the collection of the "oily products;" while the third neck is provided with a delivery-tube for the discharge of the gas, which finds its way into a glass gas-holder. The coal has been heated only for a few minutes, and the gas already begins to be freely evolved; already I may light it at the orifice of the delivery-tube, which, for this purpose, I have removed from the gas-holder; already it burns with the characteristic luminous flame of coal-gas. In the meanwhile, you observe, a considerable quantity of the "oily products" has accumulated in the receiver. Their formation continues as long as the gas is evolved. Ultimately the coal is entirely resolved into gas and oily products, a non-volatile residue, the coke, remaining behind in the retort.

It is in the oily products, the so-called "coal-tar oil," that our interest is centered. To my mind this coal-tar oil* is one of the most wonderful productions in the whole range of chemistry. That may be rather a one-sided view, but having in younger years spent much time in the investigation of this substance, I have acquired quite an affection for it. Nor can you fail to appreciate the interest which coal-tar presents to the chemist when you look at the diagram in which I have endeavoured to arrange synoptically the various substances which have been eliminated from it.

Products of the Destructive Distillation of Coal.

Name.	Formula.	Boiling Points. Degs.
Hydrogen	$H\,H$	
Marsh gas, or hydride of methyl	$C\,H_3,\,H$	
Hydride of hexyl	$C_6\,H_{13},\,H$	
Hydride of octyl	$C_8\,H_{17},\,H$	
Hydride of decyl	$C_{10}\,H_{21},\,H$	
Oiefiant gas, or ethylene	$C_2\,H_4$	
Propylene, or tetrylene	$C_3\,H_6$	
Caproylene, or hexylene	$C_6\,H_{12}$	55
Œnanthylene, or heptylene	$C_7\,H_{14}$	
Paraffin	$C_n\,H_{2n}$(?)	
Acetylene	$C_2\,H_2$	
Benzol	$C_6\,H_6$	84
Parabenzol	$C_6\,H_6$	
Toluol	$C_7\,H_8$	114
Xylol	$C_8\,H_{10}$	126
Cumol	$C_9\,H_{12}$	150
Cymol	$C_{10}\,H_{14}$	175
Naphtalin	$C_{10}\,H_8$	212
Paranaphtalin, or anthracen	$C_{14}\,H_{10}$	
Chrysen	$C_{12}\,H_4$(?)	
Pyren	$C_{30}\,H_4$	
Eupion	(?)	
Water	$\left.\begin{matrix}H\\H\end{matrix}\right\}O$	100
Hydrosulphuric acid	$\left.\begin{matrix}H\\H\end{matrix}\right\}S$	
Hydrosulphocyanic acid	$\left.\begin{matrix}H\\(C\,N)\end{matrix}\right\}S$	

* A large specimen of coal-tar oil was here exhibited.

Name.	Formula.	Boiling Points. Degs.
Carbonic oxide	C O	
Carbonic anhydride	C O_2	
Disulphide of carbon	C S_2	47
Sulphurous anhydride	S O_2	
Acetic acid	H, (C_2 H_3O), O	120
Phenylic acid, or alcohol, *phenol*	H, (C_6 H_5), O	188
Cresylic acid, or alcohol, cresol	H, (C_7 H_7), O	203
Phlorylic acid, or alcohol, phlorol	H, (C_8 H_9), O	
Rosolic acid		
Brunolic acid	(?)	
Ammonia	H, H, H, N	
Aniline	C_6 H_5, H, H, N	182
Cespitine	(C_5 H_{13})‴N	96
Pyridine	(C_5 H_5)‴N	115
Picoline	(C_6 H_7)‴N	134
Lutidine	(C_7 H_9)‴N	154
Collidine	(C_8 H_{11})‴N	170
Parvoline	(C_9 H_{13})‴N	188
Coridine	(C_{10} H_{15})‴N	211
Rubidine	(C_{11} H_{17})‴N	230
Viridine	(C_{12} H_{19})‴N	251
Chinoline, or leucoline	C_9 H_7 N	235
Lepidine	C_{10} H_9 N	260
Cryptidine	C_{11} H_{11}N	
Pyrrol	C_4 H_5 N(?)	
Hydrocyanic acid	H C N	

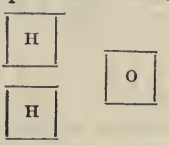
This is rather a formidable list of compounds; their names, too, are not always remarkable for smoothness and melodious character, although, I should not omit to state, they are tame and domestic when compared with some of the terms which chemists of late have been under the painful necessity of inventing and inflicting. You need not be afraid, however, that I shall trouble you with many details about these substances. Most of them, though highly interesting for more than one reason, more especially when considered from a purely scientific point of view, are of no importance for our present subject, and need not therefore specially be noticed. In fact, the only coal derivatives which, in connection with Mauve and Magenta, claim our attention, are benzol, phenol, and aniline; those certainly we must by-and-by examine somewhat more in detail.

But before doing so, you legitimately expect that I should endeavour to give you some idea of the nature of the process in which this endless variety of compounds is generated from coal. Were I to tell you simply that coal consists of carbon, hydrogen, nitrogen, oxygen, and sulphur, not to mention the ash which is left after combustion, and that you may therefore look upon coal as a sort of magazine of these several elements, capable, under the influence of heat, of associating in an infinity of forms and proportions, you would have learnt comparatively little. Let me attempt to convey to you a somewhat more precise idea of the processes involved in the distillation of coal. For this purpose you must allow me to remind you of some of the general results elaborated by the researches of chemists during the last ten years, which at the first glance appear but little connected with Mauve and Magenta.

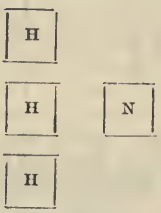
The infinite number of substances, mineral, vegetal, or animal, which form our planet, variously as they are composed, may be referred—chemists now pretty generally agree—to a comparatively small number of types of construction. Opinions are divided respecting the actual number of these types, and even the choice of typical bodies is still a subject of discussion among chemists. But whatever the special views of particular schools may be, the number of types is always small, and among them almost invariably figure hydrogen, water, and ammonia. The comprehension of the meaning attached by chemists to the term "types" may perhaps be facilitated to you by a glance at three models which I have had constructed for this purpose, and which for the sake of convenience I may be allowed to designate as type-moulds.†

Chemists assume that the smallest particle of hydrogen which exists in the free state, or, to use the chemical phrase, the molecule of hydrogen, consists of two atoms of hydrogen. The first of our type-moulds then, charged as it is with one atom (one volume) of hydrogen, associated with another atom (one volume) of hydrogen, represents the molecule of hydrogen.

In water, as you know, we have two atoms (two volumes) of hydrogen, associated with one atom (one volume) of oxygen.‡ You are reminded of this fact by our second type-mould, which represents the molecule of water.

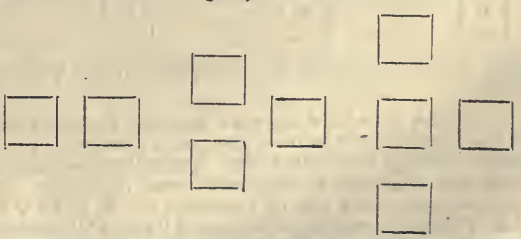


In ammonia, lastly, you have three atoms (three volumes) of hydrogen, united with one atom (one volume) of nitrogen, a form of construction which is recorded in our third type-mould representing the molecule of ammonia.



Nothing is easier now than to trace the derivation of other substances from hydrogen, from water, from ammonia. Let me remove from our three type-moulds one atom respectively of hydrogen, oxygen, and nitrogen, and fill the places thus vacated with atoms of chlorine, sulphur,

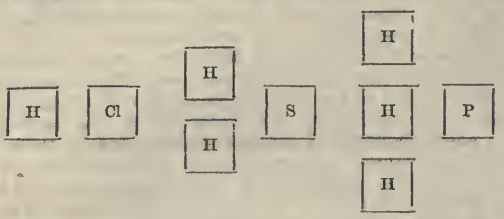
† These type-moulds consisted essentially of wire frames, presenting the outlines of cubes, associated, two, three, or four of them, in the manner indicated in the diagram,



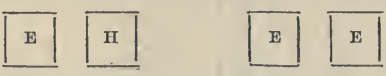
and capable of receiving zinc-cubes variously painted and marked, representing elementary and compound atoms.

‡ Equivalents used; H=1; O=16; S=32; C=12; N=14; Cl=35·5; &c.

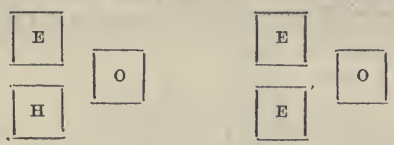
and phosphorus, and I have, without giving you the slightest inconvenience, converted hydrogen into hydrochloric acid, water into sulphuretted, and ammonia into phosphoretted hydrogen.



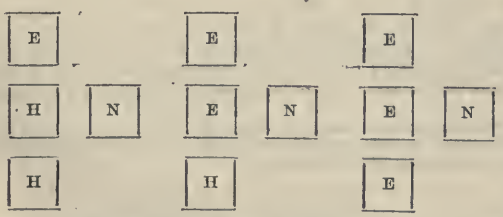
You observe the molecules of hydrochloric acid, of sulphuretted and of phosphoretted hydrogen respectively contain the same number of atoms which are present in the molecules of hydrogen, of water, and of ammonia. We have thus indicated that hydrochloric acid is constructed upon the hydrogen-type, sulphuretted hydrogen upon the water-type, phosphoretted hydrogen, lastly, upon the type of ammonia. The three bodies just considered were formed by the insertion of elementary atoms; but our type-moulds receive compound atoms with the same facility. Let me take as an illustration the compound atom, ethyl, consisting of two atoms of carbon and five of hydrogen ($C_2 H_5 = E$), which is familiar to the members of the Royal Institution. By inserting one or two ethyl atoms into the hydrogen-mould I generate the molecules of ethylated hydrogen, or ethylated ethyl (free ethyl).



In a similar manner, by introducing either one or two ethyl atoms into water, I convert the molecule of water into the molecules of the two ethylated waters, alcohol and ether.

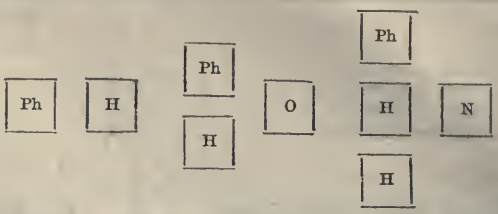


Displace, lastly, one, two, or three hydrogenatoms in ammonia, by one, two, or three ethyl atoms, and you give rise to the formation of the molecules of the three ethylated ammonias,



better known as ethylamine, diethylamine, and triethylamine.

At the risk of exhausting your patience, I repeat some of these changes with another compound atom of a composition differing from that of ethyl. These Mauve-coloured cubes may represent a compound atom, containing six atoms of carbon and five of hydrogen ($C_6 H_5 = Ph$), to which chemists have given the name of "phenyl." Charge each of our type-moulds with an atom of phenyl, and you accomplish the construction of phenylated hydrogen, phenylated water, and phenylated ammonia,



substances better known as benzol, phenol, and aniline;§ and the existence of which in coal-tar oil I have already pointed out to you.

But it is time for us to return to the point from which we started. What has the recognition of our types to do with the distillation of coal? In what manner do they explain the formation of the variety of substances generated in this process. In coal we have the elements of the three types of matter, and we find that hydrogen, water, and ammonia are in fact produced to a very appreciable extent during its distillation. The quantity of free hydrogen is generally small; moreover, mixed as it is with the carbonetted hydrogens of coal-gas, its presence among the products of distillation of coal is not easily demonstrated by experiment. Water and ammonia, on the other hand, are abundantly generated, and nothing is easier than to exhibit their production. In fact, the coal-tar oil which we have produced in our distillation experiment, is covered, as you observe, with a layer of water, and the application of test-papers to the latter shows that it contains a large amount of ammonia. Now, consider that our types are generated from coal in the presence of large quantities of carbon and hydrogen, two elements which, in proportions varying to an almost unlimited extent, may aggregate under the influence of heat to compound atoms similar to ethyl and phenyl; remember, moreover, that these atoms are capable of displacing, partly or entirely, the hydrogen of our types, and you will realise without difficulty the number of compounds which may be formed by the distillation of coal; I say which may be formed, for the diagram which I have exhibited to you enumerates only the bodies which have actually been obtained; but every day brings forth new substances. It is obvious that the nature of the compound atoms generated must, in a measure, depend upon the composition of the coal distilled. The composition of coal, however, varies between very considerable limits. In the subjoined diagram I give you a synopsis of the results obtained in the analysis of several specimens of coal.

ANALYSIS OF DIFFERENT COALS.

Locality of coal.	100 Parts of Dry Coal						
	Contain					Leave	
	Carbon.	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.	Ash.	Coke.
Anthracite, Wales ..	91·44	3·36	0·21	0·79	2·58	1·52	92·20
,, ,, ..	90·39	3·28	0·83	0·91	2·97	1·61	92·10
Caking Coal, Newcastle	81·41	5·83	2·05	0·75	7.90	2·07	66·70
Cannel Coal, Wigan ..	80·07	5·53	2·12	1·50	8·09	2·70	60·36
Coal, Wolverhampton..	78·57	5·29	1·84	0·39	12·88	10·30	57·21
Wallsend, Elgin ..	76·09	5·22	1·41	1·53	5·05	10·70	58·40
St. Helens, Lancashire	75·80	5·21	1·92	0·90	11·89	5·17	65·50
Methill Brown Coal ..	65·96	7·78	0·96	0·75	9·23	15·32	
Bohemian Brown Coal	55·59	4·16	19.06			21·19	

A glance at this diagram shows you that the carbon in the several specimens varies by more than 30 per cent.

§ Large specimens of these three substances were exhibited upon the table.

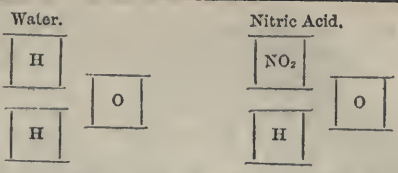
being 91·4 in Welsh anthracite, and 55·5 in Bohemian brown coal. Similar, though less marked discrepancies are perceptible in the other constituents. If you recollect, in addition, that the nature of the compound atoms generated in the distillation of coal must be influenced, moreover, by the temperature, which again oscillates between limits widely apart, you cannot fail to perceive that the destructive distillation of coal must be an almost inexhaustible source of new compounds.

The separation of the individual substances from the complex mixture called coal-tar oil appears, at the first glance, to present almost insurmountable obstacles. But the principles made use of for this purpose are very simple. The individual compounds contained in coal-tar oil may be separated in a great measure by distillation, their boiling points varying, as may be seen by a glance at the diagram, to a considerable extent. But additional means of purification offer themselves in the different deportment which these substances exhibit under the influence of chemical agents. I could not, perhaps, in this respect, bring under your notice a more instructive illustration than the behaviour with acids and bases of the three coal-tar oil constituents, repeatedly quoted. Benzol, phenol, and aniline, may thus easily be separated. To demonstrate this point experimentally, two glass cylinders have been half-filled with benzol, two others with phenol, and two further ones with aniline; a solution of litmus having, moreover, been added, each of the three substances is treated in one cylinder with acid, in the other with alkali. In the case of benzol, you observe the indifferent hydrocarbon, insoluble both in acid and alkali, floating colourless upon the coloured liquid; phenol, being an acid water derivative, is not acted upon by the acid, but readily dissolves in the alkali; aniline, lastly, being a well-defined ammonia derivative, exhibits the converse deportment, resisting the action of the alkali, and forming a homogeneous solution with the acid.

Each of the three coal-tar oil constituents which I have mentioned, and of which you have characteristic specimens upon the lecture-table, has received important applications in the arts and manufactures. Benzol is the most convenient solvent for caoutchouc; as an agent for removing oil and grease it has become an ordinary household article; phenol, when treated with nitric acid, yields us a beautiful yellow dye, called by chemists "carbazotic acid;" but the practical interest attached to phenol you will more immediately appreciate if I tell you that this compound presents the greatest analogy with creosote, a substance, I am afraid, but too well known to most of us,—a considerable portion of the creosote of commerce being in fact simply phenol; aniline, lastly, is the source of Mauve and Magenta, and must therefore claim our attention more particularly this evening.

The amount of aniline which exists in coal-tar is very limited; a preparation from this source upon a sufficiently large scale could never be attempted. Fortunately, chemists are in the possession of a series of processes by which aniline may be produced in any quantity. Benzol, the phenylated hydrogen, may readily be converted into aniline, the phenylated ammonia. Let us examine this transformation experimentally.

Benzol is readily attacked by fuming nitric acid; it dissolves in it, producing a liquid of a deep-red colour. On addition of water this liquid deposits a heavy yellow oil, collecting at the bottom of the cylinder, perfectly different from benzol, which floats on the surface of the water. The reaction will be intelligible to you, if I remind you that nitric acid when referred to our types, must be viewed as a water derivative; it is water in which, for one of the elementary hydrogen atoms, there has been substituted a compound atom, consisting of nitrogen and oxygen.



Modern chemistry, you observe, returns to the conceptions of former ages, which in the name "aqua fortis" appear to have anticipated in a measure our present notions.

When nitric acid acts on benzol, an interchange takes place between the elementary atom of the latter and the compound atom of the former, "nitrobenzol," the heavy yellow liquid, which we have produced, and water being formed:—

Benzol. Nitric Acid. Nitrobenzol. Water.

$$(C_6H_5)H + \left.\begin{matrix}NO_2\\H\end{matrix}\right\} O = (C_6H_5)(NO_2) + \left.\begin{matrix}H\\H\end{matrix}\right\} O$$

The transformation of benzol into nitrobenzol, discovered by Mitscherlich, is only a preparatory operation for the production of aniline. The method of converting nitrobenzol into aniline was discovered by Zinin. It consists in submitting nitrobenzol to the action of nascent hydrogen. Under the influence of this agent, the compound atom NO_2, which in nitrobenzol is associated with phenyl, is decomposed; its oxygen is converted into water, the residue of nitrogen and phenyl assimilating the necessary quantity of hydrogen to form phenylated ammonia, or aniline.

Nitrobenzol. Hydrogen.

$$(C_6H_5)NOO + HH + HH + HH =$$

Aniline. Water.

$$\left.\begin{matrix}H\\H\end{matrix}\right\} O + \left.\begin{matrix}H\\H\end{matrix}\right\} O + \left.\begin{matrix}(C_6H_5)\\H\\H\end{matrix}\right\} N$$

The hydrogen necessary for this transformation may be furnished by numerous processes. The most convenient method for our purpose consists in submitting nitrobenzol to the action of metallic iron and acetic acid, a process first proposed by M. Béchamp. I mix the three bodies in a glass retort, and on application of a gentle heat you observe how immediately a most powerful reaction manifests itself. Let us hasten to connect the retort with a condenser; I have removed the gas-burner from the retort; nevertheless the reaction continues, and a considerable quantity of water, covering an oily layer, has already accumulated in the receiver. The oily liquid is aniline. We recognise it at once by its peculiar deportment with a solution of chloride of lime. On pouring a single drop of our distillate into this beaker which contains a solution of chloride of lime, a splendid purple cloud is almost instantaneously diffused throughout the liquid. You perceive we are approaching our subject. The beautiful colour which aniline strikes with a solution of chloride of lime has been long known. A solution of bleaching powder has always been used as a test for aniline; indeed, it was by this colour reaction that the presence of our compound in coal-tar oil was first pointed out, a fact recorded in the name Kyanol (blue oil), originally given to aniline prepared from coal-tar. Several other oxidising agents, chromic acid for instance, were likewise known to produce coloured compounds from aniline; but all the colours thus obtained were of a highly ephemeral character. Observe how the purple cloud which I produced by means of chloride of lime has rapidly changed to a dingy reddish precipitate. It was Mr. W. Perkin who had first the happy idea of investigating the circumstances under which this beautiful purple might be prepared in a form permanent and applicable for the purposes of the dyer. He succeeded in isolating this colour by submitting, under appropriately selected circumstances, aniline to the action of bichromate of potassium and sulphuric acid.

Here then you have, step by step, the development of this new and important branch of chemical industry.

Through the kindness of my friend Mr. Perkin, I am enabled to exhibit to you magnificent specimens of his aniline purple, or Mauve, in the dry state and in solution. This brown lump, with the remarkable coppery lustre, is Mauve in the solid state; its extraordinary tinctorial powers will be appreciated, if I tell you that this beautiful violet-coloured solution contains not more than $\frac{1}{10}$th of a grain of Mauve in one gallon of alcohol; you will also understand the considerable commercial value of this substance. Weight for weight, I am told by Mr. Perkin, this colouring matter, when pure, is sold at the price of metallic platinum.

Very little is known regarding the chemical nature of Mauve; its composition is not yet made out, and, as a matter of course, the process by which it is formed from aniline remains as yet perfectly unexplained.

Magenta is one of the fancy names given to the splendid crimson, which is likewise generated from aniline by the action of oxidising agents. This substance was first observed in purely scientific researches, and more especially in the action of tetrachloride of carbon upon aniline. To a French chemist, M. Verguin, the merit is due of having for the first time obtained this substance on a larger scale; he produced it by the action of tetrachloride of tin on aniline. Numerous other processes were subsequently suggested, among which treatment of aniline with chloride or nitrate of mercury with arsenic acid, and many other substances may be mentioned. Magenta, often called fuchsine, roseine, &c., soon became an article of large consumption. A great impetus to this new branch of industry was given in France by Messrs. Renard and Franc, who were the first to manufacture the new article on a commercial scale; in this country, very soon afterwards, Messrs. Simpson, Maule, and Nicholson engaged with great spirit in the manufacture of this splendid dye, the production of which has attained already colossal proportions. To Mr. E. C. Nicholson more especially belongs the credit of having developed this new industry to an unprecedented degree of perfection.

Before proceeding, however, let me show you the formation of Magenta by experiment. Among the many processes which I might adopt for this purpose I select the action of corrosive sublimate upon aniline, not because I consider this process superior to the others,—it is, in fact, inferior to many,—but because it is, perhaps, the best adapted for a lecture experiment. This white powder is chloride of mercury (corrosive sublimate); a small portion of this salt I mix in a test-tube with perfectly colourless aniline. Let us stir the mixture with a glass rod until it is converted into a perfectly homogeneous liquid paste. This paste is still colourless, but on gently heating it by a gas-burner, it instantaneously assumes a splendid crimson of the greatest intensity, a single drop of the liquid being capable of deeply colouring a large beaker filled with alcohol.

In all the processes which convert aniline into colouring matters, a considerable number of secondary products are generated, which it is rather difficult to separate from the principal product of the reaction. These difficulties have been most perfectly overcome by Mr. Nicholson, who has succeeded in obtaining Magenta in a state of absolute purity. Chemists have thus been enabled to analyse this substance, and to lift, at all events, the corner of the veil which still covers the mysterious formation of the coloured derivatives of aniline.

In the pure state, Magenta is a fine crystalline, and, remarkably enough, perfectly colourless, or only slightly-tinted body, which is represented by the formula—

$$C_{20}H_{21}N_3O = C_{20}H_{19}N_3,H_2O.$$

Rosaniline (this is the name by which chemists designate the colourless body) is a base, or ammonia derivative, which forms a series of splendid salts. With hydrochloric acid, for instance, it produces a beautifully crystalline salt of the formula—

$$C_{20}H_{19}N_3,HCl.$$

It is in the state of saline combination that rosaniline acts as a crimson dye. Into this shallow porcelain dish I have thrown a few crystals of rosaniline, which at a distance you scarcely perceive; I now pour upon these crystals a small quantity of acetic acid, when on gently heating the dish the crimson colour instantaneously appears. But it is only in solution that even the salts of rosaniline are crimson coloured; on slowly evaporating their solution, the red colour entirely vanishes, and a splendid green crystalline substance remains, presenting in an extraordinary manner the beautiful metal lustre which distinguishes the wings of the rose-beetle. Together with all the products involved in the manufacture of aniline and aniline dyes, my friend Mr. Nicholson has placed before you the finest series of rosaniline salts which has ever been produced; and not content with this display, he was kind enough to send us a specimen of acetate of rosaniline, such as no mortal eye has ever seen before. The specimen may be literally called the "Crown of Magenta."‖ Crowns are always expensive articles, and often are the cost and trouble of getting them greater than their actual value. This remark applies in a measure to the Crown of Magenta. For the benefit of those who are fond of big figures—and who is not a little afflicted with this weakness?—I may state that the crown was grown in a vessel containing not less than 8000*l.*-worth of Magenta, the crown itself being worth upwards of 100*l.*

Having now explained the several stages of transition through which coal has to pass before it becomes either Mauve or Magenta, it may be of some interest to you to know the proportion which the finished dye bears to the coal from which it is derived. A set of specimens for which I am likewise indebted to Mr. Nicholson, is most instructive in this respect. Observe, it commences with a large mass of coal, weighing not less than 100 lbs.; the bottles which follow contain the coal-tar oil, naphtha, benzol, nitrobenzol, and aniline, obtainable in succession from 100 lbs. of coal; remark how they gradually diminish in size, and how small, I might almost say insignificant, appears the bulk of Magenta finally obtained. But compare the bulk of wool which this minute quantity will dye. It approximates to the bulk of coal with which we started. This comparison evinces, perhaps, sufficiently the extraordinary tinctorial power which this class of dye possesses, but a very simple experiment may possibly convey to you this idea even in a more impressive manner. The white paper which covers this large frame has been dusted over with a minute quantity of Mauve; a second one is treated in a similar manner with Magenta. The quantity of colouring matter is so small, that the paper has retained its original white colour; but observe how it changes when I dash a beaker full of spirit against these squares; immediately the lovely purple of Mauve is developed upon one of them, whilst the other one exhibits the dazzling crimson of Magenta.

But let us now proceed to illustrate the mode of dyeing. For this purpose I introduce silk and wool, both unspun and woven, in succession, into solutions of Mauve, of Magenta, and, lastly, of a splendid new purple, lately discovered by Mr. Nicholson. Observe the extraordinary facility with which the coal-tar colours are fixed both on wool and silk. These materials require no previous preparation, being dyed, in fact, simply by dipping, without the aid of any mordant. Silk and wool are animal substances; vegetal materials, such as cotton and linen, unless previously submitted to a special treatment, are scarcely

‖ An immense aggregate of sparkling green octohedral crystals,—some of them as much as an inch in diameter,—deposited upon a large wire frame having the shape of an elegant crown, was here exhibited.

affected by these dyes. This fact admits of being beautifully illustrated by dyeing linen fabrics on which ornaments have been embroidered in silk ribbon. The articles, when coming out of the bath, appear uniformly dyed; but by washing, first in pure water and then in dilute ammonia, the colour rapidly vanishes from the linen ground, leaving the silk embroidery in brilliant colours. This extraordinary predilection of the aniline colours for animal substances is, moreover, strikingly illustrated by the condition of my hands, which by this time have acquired a thoroughly Magentic appearance. Fortunately, the coal-tar colours are unable to resist the action of chloride of lime, and I have therefore only to immerse my hands for a moment into a solution of bleaching powder.

Already the colour on my hand, you observe, has gone, but with the colour, I am afraid, my time too. Let me endeavour to bring this lecture to a conclusion. I have fulfilled in a measure the promise which I gave you at the commencement of this discourse. We have crossed together the extensive field which stretches between coal and colour. I am impressed, deeply impressed, with the clumsiness of my performance as your guide, but I hope that the interest attached to the territory we have explored may, to some extent at all events, have indemnified you for the imperfection of my explanations, and that you leave the Royal Institution this evening with the kind of feeling every one of us has more than once experienced after travelling in similar company over a beautiful country—the guide is forgotten, but the impression of the scenery remains.

Having gone thus far, you may think that it is fully time for me to make my bow. But I venture, even at this late hour, to dwell for a moment on the *moral* of the story which I have told you, though you may feel disposed to consider this story rather a highly coloured one.

The material which I had to condense, I might almost say to force, into the short space of an hour, has been overwhelming; and whilst explaining the formation of the various substances which I had to describe, whilst illustrating their properties by experiment, I have scarcely had time to glance at the history of our subject. This history is not without interest. You readily perceive that a branch of industry like the one I have endeavoured to sketch could not possibly have risen like Minerva from the head of Jupiter—a sudden inspiration happily realised. The time, the toil, the thought of a host of inquirers were necessary to accomplish so remarkable an achievement. You cannot expect me at this late hour to examine minutely into this part of the subject, but I must not take leave of you without alluding to some facts which cannot fail to rivet the lively interest of the Members of this Institution. Let me tell you then that Mauve and Magenta are essentially Royal Institution colours; the foundation of this new industry was laid in Albemarle Street. Benzol, which I have so repeatedly mentioned,—benzol, which may be looked upon as the raw material, capable, under the influence of chemical agents, of assuming such wonderful shapes,—benzol is the discovery of our great master, may I not add of our kind friend, Mr. Faraday. This volume, "The Philosophical Transactions for 1825," contains the description of his experiments. In 1825, thirty-seven years ago, the laboratory of the Royal Institution witnessed the birth of this remarkable body. Yesterday, under the auspices of Mr. Anderson, I invaded the same laboratory, a diligent search was made, and in my hand I hold the trophies of our expedition, the original specimens of benzol which Mr. Faraday prepared. In thus reminding you of one of the early labours of Mr. Faraday,—which, owing to the number and vastness of his subsequent discoveries, appears almost to have escaped from his memory like a tradition of years gone by,—I have opened a glorious page in the glorious history of the Royal Institution. Benzol has furnished us Mauve and Magenta, but it has done much more than this. Ever since chemistry became endowed with this wonderful body, benzol has been the carrier of many of the leading ideas in our science. In the hands of Mitscherlich, Zinin, Gerhardt and Laurent, in the hands of Charles Mansfield —never to be forgotten by his friends—and many others, benzol has been a powerful lever for the advancement of chemical science. Benzol and its derivatives form one of the most interesting chapters in organic chemistry, the progress of which is intimately allied with the history of this compound.

But what has the history of benzol to do with the moral of Mauve and Magenta? Well, ladies and gentlemen, ask Mr. Faraday; ask him what in 1825 was his object in examining benzol. I have perhaps no right to answer this question in Mr. Faraday's presence; but I venture to say that we owe his remarkable inquiry to the pure delight he felt in the elaboration of truth. It was in the same spirit that his successors continued the work. Patiently they elicited fact after fact; observation was recorded after observation; it was the labour of love performed for the sake of truth; ultimately, by the united efforts of so many ardent inquirers, exerted year after year in the same direction, the chemical history of benzol and its derivatives had been traced. The scientific foundation having thus been laid, the time of application had arrived, and by one bound, as it were, these substances, hitherto exclusively the property of the philosopher, appear in the market-place of life.

Need I say any more? The moral of Mauve and Magenta is transparent enough. I read it in your eyes,—we understand each other. Whenever in future one of your chemical friends, full of enthusiasm, exhibits and explains to you his newly-discovered compound, you will not cool his noble ardour by asking him that most terrible of all questions, "What is its use? Will your compound bleach or dye? Will it shave? May it be used as a substitute for leather?" Let him quietly go on with his work. The dye, the lather, the leather will make their appearance in due time. Let him, I repeat it, perform his task. Let him indulge in the pursuit of truth,—of truth pure and simple,—of truth not for the sake of Mauve, not for the sake of Magenta—let him pursue truth for the sake of truth!

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

887. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "Improvements in the manufacture, from vegetable product, of glucose or fermentable sugar."—A communication from Martial Victor Jouannet, Faurelles Commune, Jurignac Charente, France.—Petition recorded March 31, 1862.

1520. Marc Antoine François Mennons, Rue du Mont Thabor, Paris, "Improved processes for the conversion of amylaceous matters into saccharine and other useful products."—A communication from Georges Serret, Paul Hamoir, and Achille Duquesne, Faubourg de Paris, Valenciennes, France.—Petition recorded May 20, 1862.

1875. Thomas Rainforth Tebbutt, Manchester, "Certain improvements in the manufacture of soap, soda, and other material employed for the purpose of washing and cleansing."

1880. John Henry Johnson, Lincoln's Inn Fields, London, "A new composite fluid to be used for illuminating purposes." — A communication from Benjamin Hebard, Dorchester, Massachusetts, U.S.—Petitions recorded June 26, 1862.

1883. Charles Cochrane, Ormesby Ironworks, Middlesbro'-on-Tees, "Improvements in the manufacture of aluminate of soda and potash."

1885. Charles Cochrane, Ormesby Ironworks, Middlesbro'-on-Tees, "Improvements in the manufacture of iron."

1891. Alexander Angus Croll, Coleman-street, London,

"Improvements in the treatment of ammoniacal liquor of gasworks."

1919. George Henry Birkbeck, Southampton Buildings, Chancery Lane, London, "Improvements in processes for the utilisation of certain refuse products resulting from the manufacture of iron, such processes being applicable to the treatment of other metallic or mineral substances."—A communication from Emmanuel Minary and Raymond Soudry, Paris.

1924. Eugene De Labastida, Hart Street, Bloomsbury Square, London, "A new method of manufacturing india-rubber articles by the simultaneous combination of pressure and vulcanisation."—A communication from Albert Cohen and Charles Vaillant, Harbourg-upon-Elbe (Hanover).

1953. Arthur Warner, Threadneedle Street, London, "Improvements in preparing materials for and in purifying coal-gas."—Petitions recorded July 5, 1862.

1984. Emile Jaudeau, Guildford Road, Brighton, Sussex, "An improved method of, and apparatus for, removing the bad flavour from alcohols distilled from grain, beet-root, or other vegetables, and for extracting the whole of the alcohol contained in the fermented juice."

1988. Joseph Ponti, New Bond Street, London, "An improved apparatus for viewing photographic pictures, and the preparation of photographic pictures to be used in such apparatus."—A communication from Carlo Ponti, Venice.—Petitions recorded July 10, 1862.

2018. Adolphe Antoine Gannal, Paris, France, "Certain improvements in the manufacture of bituminous cement."—Petition recorded July 14, 1862.

2044. James Dickson, Tollington Road, Holloway, London, "Improvements in the manufacture of caustic soda and carbonate of soda."—Petition recorded July 17, 1862.

2062. Alphonse Cotelle, Saint Quentin, France, "Improvements in the manufacture of alcohol."

2072. Thomas Davey, Tuckingmill, Cornwall, "Improvements in the manufacture of gunpowder and explosive compounds."

2082. Joseph Daniels, Leigh, Lancashire, "Certain improvements in artificial manure."

2090. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the treatment of the noxious gases or vapours produced in the distillation or purification of tar."—A communication from Pierre Louis Joseph Semet, Paris.—Petitions recorded July 22, 1862.

CORRESPONDENCE.

On the Chemical Reactions for Morphia and Strychnia.

To the Editor of the Chemical News.

Sir,—Since the publication of the two new processes for the detection of morphia, viz., the silver and the iron test, I have been considering their different reactions, and it would appear that they are precisely the inverse of each other; for whereas in the former the morphia acquires oxygen from the silver, reducing it and becoming itself partially decomposed, in the latter it gives out all its oxygen (morphia containing eight atoms), and is entirely destroyed. To prove this, a mixture of morphia and sulphate of iron was exposed for a few minutes to the heat of a water bath, when a colourless liquid was produced with an abundant precipitate of peroxide of iron, but no change was produced with ferrocyanide. Hence it is not difficult to understand the reaction when ferridcyanide of potassium is used,—the morphia parting with its oxygen to the iron, and the subsequent action of ferridcyanogen, or rather ferridcyanic acid upon it is the probable cause of the deep cherry-red colour.

On the other hand, strychnia contains only four atoms of oxygen,—hence its deficiency explains the reaction of oxide of manganese and all chromates; the strychnia from acquiring fresh oxygen in a direct way becoming probably converted into strychnic acid, which with sulphuric acid gives rise to the purple colour; but the effect of ferridcyanide of potassium, which contains no oxygen, is explainable on a totally different ground, being less direct, as hydrogen is taken from the water of the hydrated sulphuric acid, the oxygen being set free and uniting with the strychnia developes colour in consequence.

We have now several new, unique, and valuable tests for morphia added to our stock, sufficient for all time and emergencies, which afford me some little satisfaction for the ungenerous treatment I have recently experienced for several weeks past entirely from misguided zeal. And as for my much derided compound for the detection of strychnia, I assert, notwithstanding what has been said to the contrary, that it will be found, unmistakeably, superior in delicacy to any other I have seen published.

I am, &c.

John Horsley, F.C.S.

The Laboratory, Cheltenham.

On the Reaction of Ferricyanide of Potassium on Morphia.

To the Editor of the Chemical News.

Sir,—In addition to the beautiful method of reducing silver by morphia described by me in the Chemical News of July 5, by which I have coated several glasses with pure silver, I have now to notice another singular peculiarity, which I am not aware has ever been observed before; viz., if a few drops of a solution of either acetate or hydrochlorate of morphia be mixed with about four or five times its bulk of a solution of ferricyanide of potassium, after a few hours it will have assumed a deep cherry-red colour.

I am unable to assign the cause of this reaction, but have repeated the experiment several times with the like result; so that this peculiarity may possibly be of some use as a new test for the presence of morphia. No such reaction takes place with the ferrocyanide.

To prove that the colour was not due to oxidisement from the air, a drachm of the plain solution of ferridcyanide was exposed in a test-glass for several hours beside another glass containing a mixture of morphia and the reagent, whilst another portion was placed in a corked phial. In both instances the mixtures became of a cherry-red colour, but the plain solution was unaffected. A few minutes' application of the heat of a steam bath rapidly induces the discoloration of the mixed solutions, which whilst warm are of a brownish-green colour, changing to cherry-red on cooling.—I am, &c.

John Horsley.

Cheltenham, August 1.

MISCELLANEOUS.

Reports of the Juries.—The Council of the Society of Arts have felt the importance of having some permanent and authoritative record of the International Exhibition, and finding that Her Majesty's Commissioners have provided only for the publication of the awards of the Juries, but not of their reports descriptive of the progress of industry since the Exhibition of 1851, the Council have undertaken this work, with the co-operation of Her Majesty's Commissioners and of the Juries, and have placed the matter in charge of Dr. Lyon Playfair, the Special Commissioner of the Juries. The reports will be published in super royal octavo, to range with the one-volume Jury Reports of 1851. The price of the volume, bound in cloth, to Members of the Society of Arts, to Jurors, and Guarantors, is fixed at 10s.; to other persons, 15s. If bound in morocco, 7s. 6d. additional in each case. It is intended to publish the reports during the present month.

THE CHEMICAL NEWS.

VOL. VI. No. 142.—August 23, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Triethylamine, by M. CAREY LEA, *Philadelphia.*

THE triethylamine which served for the following examinations was obtained by the action of nitrate of ethyl upom ammonia, making the alkaloids thus obtained react upon fresh portions of the compound ether. The following was the course of the operation.

Three volumes of nitrate of ethyl with three volumes of liquid ammonia, thoroughly saturated with ammoniacal gas and two volumes of absolute, or nearly absolute, alcohol, were sealed up in glass tubes and were kept in boiling water for four hours. The tubes were then opened, the contents neutralised with nitric acid, and evaporated over a chloride of calcium bath. When freed as far as possible from water, the pasty mass was placed in a flask, with four volumes of absolute, or nearly absolute, alcohol and a sufficient quantity of caustic soda in powder. Heat was applied, and the vapours disengaged were conducted into three volumes of nitrate of ethyl mixed with two of absolute alcohol, kept cool by a freezing mixture. At the close of the operation it was necessary to add a little water to the contents of the flask in order to complete the decomposition. The absorption of the distillate was complete, and the liquid thus saturated was again enclosed in sealed tubes and heated. The entire number of charges was forty-two, of which five were lost by explosion. For the convenience of those who may use this method of obtaining the ethyl bases, I give the results which I observed as to the strength of tube necessary:—

Tubes of one inch external diameter, weighing			
5 ounces to the foot,	generally	burst.	
6 to 7	,,	,,	generally resisted, but not always.
8 to 10	,,	,,	were found safe.

This refers to tubes charged from three-sevenths to one-half. Beyond this charge greatly increased strength becomes necessary.*

The disposition to burst appeared to be greater in the second heating than in the first. It is therefore better to heat for 11 or 12 hours to 180°—190° F. rather than risk the loss of products which have already cost considerable time and trouble.

In describing the properties of ethylamine and diethylamine, I have shown that when nitrate of ethyl is made to react upon ammonia, the resulting alkaloids are easily separated from each other by means of picric acid. It is a familiar fact that when several salts are present in one solution the facility of separating them by crystallisation will often depend upon the relative proportion in which they are present; and this holds good in the present case. When ammonia acts upon nitrate of ethyl, and the bases, after separating the ammonia, are converted into picrates, we have a mixture of the salts of ethylamine and diethylamine in nearly equal quantities, with a variable quantity of triethylamine, always very small and sometimes a mere trace, always separating out in the first crystallisation. But when nitrate of ethyl is made to react again upon the products of the first reaction, the proportions of the alkaloids are very different. Diethylamine then constitutes about three-fourths of the whole, and the residue is chiefly triethylamine mixed with some ethylamine. When these bases are converted into picrates the diethylamine salt still separates with great facility, sinking to the bottom at a certain stage of concentration as a heavy oily fluid.† Previously to this, the picrates of ethylamine and triethylamine crystallise out in yellow needles. The separation of these last from each other by crystallisation when the triethylamine is present in considerable proportion, cannot be as satisfactorily effected as when it is present in small quantity only. It therefore became necessary to seek for a good mode of effecting this separation.

Triethylamine is but moderately soluble in water, and when the water present is insufficient to dissolve it it forms a layer on the surface. It seemed possible that its affinity for ether might be greater than for water, and experiment proved this to be the case. When ether is agitated with aqueous solution of ammonia, ethylamine, or diethylamine, it takes up but little of the base, but when agitated with aqueous solution of triethylamine it becomes strongly charged. A portion of ether agitated with a mixture of the aqueous solutions of ethylamine and triethylamine, and then treated with hydrochloric acid and bichloride of platinum and spontaneously evaporated, gave only crystals of triethylamine salt, which is easily distinguished from the platinum salt of ethylamine. No traces of the presence of the latter

* It has been very generally recommended in text-books to wrap pressure tubes in cloths to prevent the explosion of one from destroying the rest. When this is done, the extremities of the tube should always be left clear. It is at the extremity that the explosion almost always takes place, and if there is not an easy escape for the expanding vapours, so great a disturbance follows that much damage may be done. In this way I have seen every tube in a boiler broken by the explosion of one, whereas, since I have adopted the plan of leaving the ends perfectly free, when an accident has taken place I have always escaped with the loss of the one.

† The latter portions of this oily fluid which separate are often pasty with the needles of the less soluble compounds, from which they are best separated by ether in which picrate of diethylamine is extremely and the other picrates very sparingly soluble. As a proof how exactly diethylamine may be separated from its cognate bases by conversion into picrates, I subjoin analyses made at various times, some of which have been published before, others not:—

1.	·7144 grammes chloroplatinate gave Pt.	·2552
2.	·9961 ,, ,,	·3549
3.	·3884 ,, ,,	·1377
4.	1·9129 ,, ,,	·6764

These correspond to—

1.	Per cent. platinum	35·72
2.	,, ,, ...	35·63
3.	,, ,, ...	35·45
4.	,, ,, ...	35·36
Theory requires	(Pt. = 98·7) . . .	35·35
,,	,, (Pt. = 99) . . .	35·45

were observable. It therefore seemed worth while to test the process by a careful series of analyses, which was done, with the following results.

The moderately strong aqueous solution of the mixed bases, triethylamine and ethylamine, was agitated several times with about $\frac{1}{10}$th its bulk of ether, and left some time to separate thoroughly, after which the ether was removed by a separating funnel. This was repeated three or four times. It was evident that if these ethereal solutions of triethylamine thus obtained were contaminated with ethylamine, the latter substance would be present in largest proportion in the latter portions of the ether. In order, therefore, to render the test more rigorous, these latter were examined in preference, and with the following results.

Portions of the ethereal solution were treated with excess of hydrochloric acid and converted into platinum salt with excess of bichloride of platinum.

1.	·7031 grms. substance gave metallic platinum .	·2264
2.	1·2084 „ „ „ .	·3873

These correspond to—

1.	Per cent. platinum	32·20
2.	„ „	32·06
	Mean of two analyses	32·13
	Theory requires (Pt. = 98·7)‡	32·13

An eminently satisfactory result.

In order to ascertain if the whole of the triethylamine were removed by this proceeding, the aqueous solution after four washings with ether was submitted to analysis. Its chloroplatinate gave by ignition—

·6373 substance, platinum	·2487
Corresponding to, per cent. platinum . .	39·02
Theory requires	39·29

The number found falls a little below the theoretical proportion, and may indicate that a trace of triethylamine remained in the aqueous solution. I may, however, remark that this slight discrepancy is within the error of a careful analysis, particularly with substances whose analysis requires so much circumspection as these. Two analyses of chloroplatinate of ethylamine, of which the alkaloid had been separated by picric acid, gave respectively 39·02 and 39·23, the first of which numbers is identical with that above found.

Ether appears, therefore, to afford a convenient mode of separating ethylamine and triethylamine after diethylamine has been eliminated by means of picric acid. This is a necessary condition. When observed the process gives, so far as my experiments go, good results.

Properties of Triethylamine.

Triethylamine is an oily fluid lighter than water, and floating on its surface when the water present is insufficient in quantity to hold it in solution. When, therefore, the crystallised hydrochlorate is added to a concentrated solution of caustic soda, the triethylamine separates and rises to the surface. It has an agreeable ammoniacal odour, which appeared to me to be pleasanter and more aromatic than those of ethylamine and diethylamine. This, however, is a matter on which it is difficult to speak positively, as the odour of ammonias appears to be influenced by adventitious circumstances. Stas found the odour of perfectly pure ammonia prepared by him to be quite different from that ordinarily recognised as characteristic of the substance.

It is not very soluble in water, but emulsifies very easily with it. When a stratum of triethylamine is resting upon the surface of a saturated aqueous solution, a very slight agitation is sufficient to produce a complete emulsion, and a considerable time elapses before the stratum separates again. It is capable of acting under some circumstances as a reducing agent, separating gold in the metallic state with production of aldehyde, as will be described further on, but unites with chromic acid without decomposition.

Reactions of Triethylamine with Solutions of Metallic Bases.

The following reactions were obtained with a saturated aqueous solution of pure triethylamine:—

Zirconium, sulphate of zirconia—White precipitate, insoluble in excess of precipitant.

Aluminium, tersulphate of alumina—White precipitate, dissolving readily and completely in excess of the precipitant.

Glucinium, sulphate of glucina—White precipitate, insoluble in excess of precipitant.

Cadmium, sulphate—White precipitate, insoluble in excess of precipitant.

Zinc, sulphate—Same reaction.

Nickel, chloride — Green precipitate, insoluble in excess of precipitant.

Cobalt, protochloride—Greenish-blue precipitate, insoluble in excess of precipitant.

Lead, neut. acetate—The white precipitate dissolves in excess of lead solution, but is insoluble in any excess of triethylamine.

Tin, protochloride—White precipitate, insoluble in excess of precipitant.

Tin, bichloride—White precipitate, dissolving completely in excess of precipitant.

Silver, nitrate—Brown precipitate, somewhat insoluble in excess of precipitant.

Gold, terchloride—Yellow precipitate, insoluble in excess, and speedily becoming blackish.

The action of triethylamine on gold solution is remarkable, and may be considered as the most distinctive characteristic between this and the allied alkaloids. Triethylamine added to terchloride of gold throws down a yellow precipitate, which in a few moments darkens and soon appears black, but examined in thin layers is found to be dark bluish-green. This precipitate treated with hydrochloric acid partly dissolves with formation of terchloride, and leaves a residue of metallic gold in the form of a brown powder. The precipitate at first formed by the alkaloid speedily passes, therefore, into protoxide of gold. This reduction is accompanied by the evolution of aldehyde, and is carried even further than the production of protoxide, part of the gold being reduced to the metallic form; for after standing a few minutes, a bright film of gold collects on the surface of the liquid, and after a few hours the sides of the test-glass are found to be covered with a brilliant speculum of metallic gold.

Platinum, protochloride—No precipitate.

Platinum, bichloride—A saturated aqueous solution of triethylamine gives no precipitate with a concentrated solution of bichloride of platinum.

Palladium, protochloride—No precipitate.

Ruthenium, sesquichloride—No immediate precipitate. The liquid, however, soon begins to darken, and a black precipitate falls, which gradually increases until the liquid is decolorised.

Antimony, terchloride—Reddish-brown precipitate.

Uranium, nitrate—Abundant yellow crystalline precipitate, insoluble in excess of precipitant.

‡ I have taken this number for Pt. as that adopted by the last numbers of the *Jahresbericht*.

Mercury, ternitrate—Yellowish-white precipitate, insoluble in excess.

Molybdenum, protochloride—Becomes opalescent, and by standing deposits a yellowish powder.§

Molybdenum, bichloride—Brownish-yellow precipitate, insoluble in excess of precipitant.

Chromium, potash chrome alum—Greyish-green precipitate, insoluble in excess of precipitant.

Iron, ferric ammonia alum—Brown, insoluble in excess.

Copper, sulphate—Blue precipitate, of which not a trace redissolves in excess of the alkaloid. The precipitate, after treatment with a large excess of saturated aqueous solution of triethylamine, was filtered, and the filtrate tested with sulphydrate of ammonia, which gave not the slightest indication of the presence of copper.

Manganese, protosulphate—Brownish-white, insoluble in excess of precipitant.

Magnesia, sulphate—White precipitate, insoluble in excess.

Cerium, protochloride—White precipitate, insoluble in excess of the precipitant.

Cerium, nitrate of protoperoxide—Same reaction.

Reactions with Hydrofluosilicic Acids.

Aqueous triethylamine treated with ordinary hydrofluosilicic acid, $HFl,SiFl_2$, gives, when the alkaloid is in excess, a precipitate which readily dissolves in an excess of the acid.

With Knop's hydrofluosilicic acid, $2HFl,Si_2Fl_3$, no immediate precipitate is formed even when the alkaloid is in excess, but after standing some hours it becomes a slightly opalescent but almost transparent jelly, so stiff that the test-glass may be inverted without spilling it.

Observations on these Reactions.—I have already pointed out that the property of redissolving precipitates of alumina, heretofore considered as characteristic of ethylamine, is shared by both diethylamine and methylamine, and expressed the opinion that it might probably be found to extend to the other ethyl and methyl bases. The result above stated affords a confirmation of this view as regards the base now under examination.

The most important points deducible from the above described reactions may be summed up as follows:—Towards solution of aluminium, cadmium, nickel, protochloride of cobalt, and bichloride of tin, the behaviour of triethylamine is the same as that of ethylamine and diethylamine, and differs from that of ammonia. With respect to zinc, the behaviour of triethylamine resembles that of diethylamine, and differs from that of both ammonia and ethylamine. In speaking of the reactions of diethylamine, I pointed out that the oxides of silver and copper were the only ones redissolved by all three bases, ammonia, ethylamine, and diethylamine. We now see that only one, silver, is dissolved by all four, including that here investigated.

Extending the comparison to methylamine and denoting by (W.), reactions observed and recorded by its discoverer, M. Wurtz, with respect to that substance, we find that gold precipitates redissolve in excess of methylamine, but not in excess of triethylamine. Protochloride of palladium is precipitated by methylamine, and not by triethylamine. Alumina is precipitated and redissolved by both. Zinc, silver, and copper precipitates are redissolved by excess of methylamine (W.), but are insoluble in triethylamine. With respect to cadmium, nickel, and cobalt, the precipitates from solutions of these metals are insoluble in methylamine (W.) and in triethylamine.

Finally, we observe that those reactions, which may be considered as being eminently characteristic of triethylamine, are those which it exhibits with gold and with copper. These, and these only, differ essentially from the reactions of ammonia, ethylamine, diethylamine, and methylamine respectively. That with gold solution is especially interesting.

Salts of Triethylamine.

Hydrochlorate.—Crystallises with great facility in beautiful snow-white feathery laminæ. It is not in the least deliquescent in tolerably dry air; a portion left exposed for several days in a watch-glass did not exhibit the least tendency to liquefy. Carefully heated on platinum foil, it disappears without leaving any carbonaceous residue.

The most curious property of this salt is its easy combustibility. A portion of the dry salt readily ignites by contact with a lighted match, and burns with a livid green flame.

Sulphate.—Very soluble in water and alcohol. Exposed over lumps of caustic soda *in vacuo* for some weeks, it solidifies to an indistinctly crystalline mass. Heated on platinum foil, it takes fire and burns with a scarcely luminous flame and yellowish scintillations.

Nitrate.—The nitrate of triethylamine appears to be liquid at ordinary temperatures, and is obtained by neutralising aqueous triethylamine with nitric acid, gently evaporating at a low temperature until the solution is somewhat concentrated, and then placing *in vacuo* over caustic soda for some weeks. A thick syrupy liquid is thus obtained which does not crystallise. When filtering paper is imbued with this liquid and brought near to a flame, it deflagrates with a sudden flash.

A double sulphate of zinc and triethylamine isomorphous with the double sulphates of Mitscherlich's group does not appear to exist.

§ Methylamine also precipitates solutions of this salt.

On the Estimation of Phosphoric Acid,
by M. Aimé Girard.

The new method which I propose, admits of the exact and rapid estimation of phosphoric acid in the presence of oxide of iron and earthy bases. It is partly founded upon the absolute insolubility of phosphate of tin in nitric acid in presence of an excess of stannic acid, and likewise upon the easy solution of this same phosphate of tin in sulphide of ammonium.

The discovery of the former of these two facts is due to M. Alvaro Reynoso, who, indeed, made use of it to estimate phosphoric acid, by adding to the nitric solution of the phosphates a known weight of tin, collecting the precipitate obtained, and subtracting from its weight the normal weight of stannic acid which it ought to furnish. This process would be decidedly the most easy of all those which chemists have hitherto described if it possessed sufficient guarantees of accuracy; unfortunately, this is not the case. The experiments of M. Reynoso were only tried upon pure pyrophosphate of soda, and he, therefore, did not recognise the complications introduced by the presence of oxide of iron, and even of alumina.

I have, indeed, found that when tin is added to a nitric solution of these several phosphates, the stannic acid which is formed readily precipitates, it is true, all the phosphoric acid in the form of insoluble phosphate

of tin, but it also carries down in the insoluble form the greater part of the oxide of iron and a small quantity even of the alumina. These two oxides thus being added to the weight of stannic acid and phosphate of tin, naturally increase the apparent amount, and render the process quite inapplicable.

This inconvenience, moreover, is not peculiar to M. Reynoso's process; it shows itself generally in all processes in which it is proposed to throw down phosphoric acid in insoluble combinations in the presence of nitric acid, although these processes are still preferable to those in which the separation of the phosphoric acid is effected in the presence of alkaline liquids.

To overcome this difficulty, I thought of utilising the ready solubility of stannic compounds in sulphide of ammonium, and the absolute insolubility of oxide of iron and alumina in the same reagent. Operating in this manner, I am enabled in every case to separate the phosphoric acid from the different bases with which it may be combined, and to bring it rapidly to the state of ammonio-magnesian phosphate.

The analysis should be conducted in the following manner, supposing that the substance operated upon is a mixture of phosphates of lime, alumina, magnesia, and iron:—

Dissolve the substance first in nitric acid. When there are any difficulties in getting it into solution, dissolve it first in any convenient agent, then add excess of ammonia to the solution, which precipitates all the phosphoric acid, with most of the bases; well wash this precipitate; it will then be readily soluble in nitric acid.

If, for instance, a specimen of cast iron is being analysed, it must be dissolved in aqua regia; if a refractory mineral, it must be attacked by alkalies, then acidulated with nitric acid, &c. But I need not refer more particularly to these details, as they are quite familiar to all chemists.

The nitric solution having been obtained (which should be free from chloride), throw into it an indefinite quantity of pure tin. About four or five times the supposed weight of the phosphoric acid present may be employed. This tin passing to the state of stannic acid, under the influence of the nitric acid, carries down with it all the phosphoric acid, as well as a great portion of the iron and a little alumina; wash at first by decantation, and then on a filter, and place on one side the nitric solution, which is free from tin, but contains all the bases minus a portion of iron and alumina. Then redissolve the precipitate in a small quantity of aqua regia, and, without troubling about the filaments of filter-paper, or the small portions of phosphate of tin which may remain undissolved, supersaturate with ammonia, and then add an excess of sulphide of ammonium.* The stannic acid and phosphate of tin immediately dissolve, leaving a black precipitate of sulphide of iron containing alumina; allow it to stand for an hour or two, and then filter, taking care to wash the precipitate with sulphide of ammonium to remove the last traces of tin. It is then only necessary to add sulphate of magnesia to the filtered liquid to obtain the characteristic precipitate of phosphate of magnesia and ammonia. Collect this on a filter, wash it first with sulphide of ammonium, then with ammoniacal water, and afterwards calcine in the ordinary manner.

The filter containing the sulphide of iron and alumina is redissolved in nitric acid, and the filtered liquid is added to the original solution of the bases, which may then be separated in the ordinary way.

This method is as simple as it is rapid; it enables one to estimate, the same or the next day, the phosphoric acid contained in the most complicated mixtures, and then admits of the accurate separation of the bases. I have verified the value of this method by numerous and divers syntheses, and I have satisfied myself that it admits of the estimation of phosphoric acid with great accuracy.—*Bulletin de la Société Chimique de Paris.*

* The sulphide of ammonium may also be directly placed in contact with the precipitate of stannic acid and phosphate of tin; but the solution then requires longer time to effect.

TECHNICAL CHEMISTRY.

On a Green Colour which may be Employed in Confectionery.

THE finest green colour is formed, as is known, from preparations of copper and arsenic; that of which the formula is here given is devoid of danger, and may replace it. To obtain it, infuse for twenty-four hours 0·32 grammes of saffron in 7 grammes of distilled water. Then take 0·26 grammes of carmine of indigo, and infuse it in the same manner in 15·6 grammes of distilled water. Then mix the two liquids together, and a very beautiful green colour is obtained, which may be employed for colouring an immense quantity of sweetmeats (10 parts of this solution will colour 1000 parts of sugar of a very beautiful green). This colour may be preserved for a long time, either by evaporating the liquid to dryness or by converting it into a syrup.—*Journal de Pharmacie et de Chimie*, xli. 286.

On the Different Glazes used for Cooking Utensils, by M. DEPAIRE.

THE wrought and cast iron vessels which are to be placed on the fire are often covered with enamel, which protects the liquid from metallic contact with the sides.

Two compositions are generally employed for this purpose, one having for base silicate of lead, and the other boro-silicate of soda. These enamels are applied to the scoured surface of the metal in the form of a powder, which is fixed by heating it to a sufficiently high temperature to fuse it; it then spreads over and covers the metal with a vitreous varnish.

The boro-silicate of soda enamel possesses great superiority over that of silicate of lead, for it is unattacked by vinegar, marine salt, the greater number of acid or saline solutions, even when concentrated, and resists the action of the agents employed in cooking or chemical operations.

The silicate of lead enamel is whiter and more homogeneous, which explains the preference given to it by the public; but it gives up oxide of lead to vinegar or to common salt; it acts upon a great number of colouring matters, and it is attacked by nitric acid, which immediately communicates a dull appearance to it. On evaporation the liquid leaves a white crystalline residue of nitrate of lead. This enamel is instantly darkened by dissolved sulphides, and also by cooking food containing sulphur, such as cabbage, fish, and stale eggs.

It is very easy to distinguish these two enamels by means of a solution of sulphide of potassium, sodium, or ammonium. On allowing a drop of one of these reagents to fall on the vessel to be tested, the lead enamel darkens in a few moments, whilst the boro-silicate of soda enamel retains its white colour.—*Journal d'Anvers.*

PHARMACY, TOXICOLOGY, &c.

On the Preparation of Hydrate of Magnesia, by M. Am. Vée.

Since the publication of my first paper on this subject, I have striven to find out more exactly the amount of iron introduced into magnesia by calcination in metallic vessels. I find that M. Margueritte's process is as precise as it is rapid in effecting the estimation. By using a solution of permanganate of potash, so diluted that one centigramme of iron decolorises thirty-six divisions of the burette, and by operating upon quantities of magnesia varying from two to ten grammes, I have not found more than four ten-thousandths of iron. It is probable that certain specimens of magnesia, calcined in earthen crucibles, contain more.

Hitherto, powdered hydrate of magnesia has been but very little used. Nevertheless, it would be convenient to be able to prepare it beforehand. The useful properties of this hydrate have long been known. It is denser than calcined magnesia, which is an advantage, as this greater density does not prevent its ready solubility in diluted acids. To obtain it, M. Soubeiran advises exposing calcined magnesia to humid air in a closed vessel. I know not whether complete saturation can be produced by this means; but it is evident that considerable quantities of the product cannot be obtained by it. I have tried direct hydration. By moistening magnesia with just sufficient water to hydrate it, the combination is effected in twenty-four hours; but the mass becomes so hard that it is very difficult to pulverise it; so that I was compelled to abandon this method, which otherwise had the advantage of rendering all drying unnecessary. I used a larger quantity of water, and hastened the combination by the application of heat. I boiled the magnesia for twenty minutes in twenty times its weight of water. The product was thrown on a cloth, drained, and put on plaster plates, which rapidly absorbed the greater part of the water. The desiccation was completed on a stove, the temperature of which could be raised to 100° without evaporating the last equivalent of water. The dry mass is very friable. It contains about 30 per cent of water.—*Répertoire de Chimie.*

Medico-Legal Contributions on Arsenic, by Charles H. Porter, *M.D.,* Professor of Chemistry and Medical Jurisprudence, Albany Medical College.*

(*Continued from page 62.*)

It is not necessary to give in detail the proper mode of using the apparatus; suffice it to say that zinc and water being placed within the generator, diluted sulphuric acid (one of acid to three of water), previously cooled, is to be added. When the air is driven out the tube may be heated; if, after the lapse of an hour or two, no stain is produced in the tube, the supposed arsenical liquid may be introduced and tested. It is advisable to obtain mirrors at different parts of a number of tubes, and spots upon a number of pieces of porcelain, such as crucible covers; if the arsenic is present in but minute quantity, no spots can be obtained on the porcelain. (See Flandin's method of procedure, "Traité de Poisons," t. i. p. 621.) The delicacy of Marsh's test is very great; thus Storter shows that the $\frac{1}{3000}$th of a grain of arsenious acid in more than ten million times its weight of water will give a distinct stain in the reduction tube. (*Am. Acad. Arts and Sciences, Proc.*, vol. viii. p. 79.)

We may notice briefly some of the more simple modes of distinguishing between the mirrors and spots produced by arsenic and antimony.

1. *Treatment of the Mirrors in the Reduction Tube.*—*a.* The arsenical mirrors are always produced beyond the heated part, while antimoniuretted hydrogen, being more easily decomposed by heat than is arseniuretted hydrogen, produces a mirror before as well as beyond the heated part.

b. Arsenic mirrors are of a lustrous, blackish-brown colour, and when thin are semi-transparent. Antimony mirrors are fused into small, silver-white globules, near the heated part of the tube; beyond, they are dull and almost black.

c. If a very slow stream of dry sulphydric acid is passed into the tube, and the mirror is gently heated, it will, if arsenic, be converted into the yellow sulphide of arsenic, and if antimony, into the orange or black sulphide of antimony.

d. If dry chlorhydric acid gas be passed into the tube (treated as above), when cold the deposit, if of sulphide of arsenic, remains unchanged, if of sulphide of antimony it is converted into chloride of antimony, and is volatilised. (The spot, if unchanged, may be dissolved in ammonia, and further experimented with.)

2. *Treatment of the Spots on Porcelain.*—*a.* Arsenic spots when moistened with a solution of hypochlorite of soda immediately disappear. Antimony spots are not affected, at least, not until after a long time.

b. An arsenic spot treated with a drop of yellow sulphide of ammonium dissolves slowly and imperfectly; an antimony spot rapidly disappears. If, after this treatment, they are allowed to dry, the antimony spot assumes a rich orange tint, the arsenic spot a light lemon colour on the borders, with a larger or smaller mass of undissolved metal in the centre.

It may be remarked, that not unfrequently solutions containing organic matter are introduced into Marsh's apparatus. This is extremely improper, for organic matter alone occasionally produces mirrors similar to those obtained by arsenic and antimony, and if these metals are present the indications are neither so clear nor so satisfactory as when pure solutions are used.

4. Reinsch's Test.—Hugo Reinsch published in 1843 (*Ann. d'Hygeine*, 1843, vol. i. p. 439) a simple method of detecting arsenic. It may be stated as follows: The suspected mass, if not liquid, is to be finely divided, placed in a porcelain dish with water, and chlorhydric acid added until distinctly acid. The mixture is then to be boiled until it becomes, as far as possible, homogeneous. It is then to be strained or filtered, and boiled again with strips of bright copper foil or gauze. Arsenic, if present, is deposited upon the copper, which becomes blackened. The metallic slips are then carefully washed, dried, and heated in a glass tube closed at one end, when arsenious acid sublimes, which may be recognised by its solubility in water and by the liquid tests noted hereafter. (The liquid prepared from the suspected organic matter, in the manner previously mentioned, is admirably fitted for this purpose.) Lippart has shown (*Journ. für Prak. Chem.*, lxxxi. p. 16) that the deposit is not pure arsenic, as was generally supposed, but a combination of arsenic and copper (Cu 68, As 32 per cent.), and that by continued heating of this deposit in hydrogen gas it loses only 7 per cent. of arsenic, and that then if ignited in air the greater part of the arsenic remains.

* Communicated by the author, having been presented to the Medical Society of the State of New York.

Reinsch's test is readily made. It is not, however, so delicate as Marsh's test. There are a number of objections to it, the most important of which are the following:—

1. If the arsenic is in minute quantity, the deposit on copper will not produce arsenious acid in sufficient quantity to make the confirmatory tests.

2. If sulphide of arsenic is present it escapes detection altogether. In this state arsenic often exists in the remains of those poisoned by it who have been dead a considerable time. Arsenic is often contained in the commercial copper, and hence, under certain circumstances, as when free chlorine is present in the liquid examined, a deposit of arsenic would be produced, even if the liquid did not contain it originally.

5. Fresenius' and Babo's Apparatus.—Arsenious and arsenic acids, and their corresponding earthy and alkaline salts, when ignited with a mixture of cyanide of potassium and carbonate of soda, yield up all their arsenic in the metallic state. If the tersulphide of arsenic be employed, the greater part of the metal is reduced; the remainder forms a sulpho-salt unacted upon by cyanide of potassium. If an excess of sulphur is present the metal remains in great part or wholly unreduced. If the ignition is made in a sealed glass tube, sealed at one end, a part of the arsenic may be oxidised by the air, and thus, if it be present in small quantity, it may escape detection. To avoid this result, Fresenius and Babo recommend an apparatus in which the reduction takes place in an atmosphere of carbonic acid.

The flask for the evolution of carbonic acid is partially filled with lumps of marble or compact limestone. It is closed by a cork, containing two perforations, into one of which is fitted the funnel tube, into the other perforation is a tube connecting the two flasks. The second flask contains concentrated sulphuric acid, which dries the gas as it passes through it. The mode of using the apparatus is as follows:—The sulphide of arsenic, or preferably the arsenate of soda, prepared from the suspected matter as already mentioned, is pulverised in a warm mortar with ten parts of a well-dried mixture, consisting of three parts of carbonate of soda and one part of cyanide of potassium. The powdered mass is then placed on a slip of glazed card paper, bent into the shape of a gutter, and pushed into the reduction tube to its centre. By turning the card the mixture is deposited without soiling other parts of the tube. The card is then withdrawn and the tube connected with the apparatus, supporting its free end if necessary. The tube ought to be of Bohemian glass, and about one-fourth of an inch external diameter. Chlorhydric acid is now added to the flask containing the marble; the carbonic acid evolved is dried in the other flask. The reduction tube must now be gently heated throughout its whole length until all moisture is expelled, both from its walls and from the mixture. When this is accomplished, and when (the air having been completely driven out) the bubbles of carbonic acid gas pass through at the rate of one a second, a lighted lamp may be placed in front of the mixture, and the mixture heated by another lamp flame. The greater part of the arsenic will condense near the drawn out end of the tube; a small portion will escape from the tube, producing a garlic odour in the atmosphere. By carefully heating the tube before and behind the deposit it may be collected in a small spot, and will have a highly lustrous metallic appearance. If it is to be preserved, the point may be sealed by the blow-pipe flame, the other extremity drawn out and sealed in a similar manner. The deposit may, of course, be converted into arsenious acid by oxidation, dissolved in water, and the liquid tests applied.

The advantages of Fresenius' and Babo's test are these:—

1. It is simple and easy of execution.

2. It is impossible to confound arsenic with antimony. Antimony compounds do not furnish any deposit under these circumstances.

3. It is a delicate test; the $\frac{1}{300}$th part of a grain may be detected by careful manipulation. It is not, however, nearly so delicate nor so readily applied as Marsh's test.

6. Reduction Test.—Liquid Tests.—*a. The reduction test* now to be considered is the same as the last, except that the arsenic is volatilised in air instead of in carbonic acid. A number of tubes are to be prepared, with a bulb on one extremity. The mixture of the arsenical compound, carbonate of soda and cyanide of potassium, is to be introduced into the bulb of the tube by means of a paper gutter, as already mentioned, not more than half filling it. The bulb is first to be gently warmed (and if moisture escapes it should be removed with a twisted slip of paper), afterwards it is to be heated till the mass fuses, and finally more intensely. By this means an arsenic mirror is obtained of great purity and beauty.

b. Odour Test.—If the tube be cut off just below the mirror, and if then it is held inclining upwards in the flame of an alcohol lamp, the flame will be tinged bluish white, and the characteristic garlic odour may be perceived.

c. Guy's Method of Reduction.—As it is often difficult to distinguish the octahedral form of the arsenious acid crystals, or critically to examine the deposits, when the quantity is small and contained in a tube, Guy proposes the following method:—

A tube is employed three-fourths of an inch in length, and of rather larger diameter than is commonly employed. This tube is supported in a vertical position by being dropped into a hole punched in a slip of copper foil. The arsenical mixture is then dropped into the tube, and heat carefully applied to the closed end; at the same time a clean microscopic glass cover or a glass slide is placed over the open end of the tube. Crystals of arsenious acid are thus produced, which may readily be examined by the microscope. When metallic arsenic is sublimed, the crust is found to consist of a multitude of globular particles, or if partially oxidised, of octahedral crystals mixed with the globules. The delicacy of this test is such, that with the $\frac{1}{1000}$th of a grain of arsenic thousands of distinct octahedral crystals of arsenious acid may be obtained. (*Archives of Medicine*, No. 3, p. 25.)

d. Oxidation Test.—If the closed end of the tube be cut off and the mirror is carefully and gradually heated, the arsenic will volatilise, and oxidising becomes converted into arsenious acid, which will condense in the cooler part of the tube in a mass of minute octahedral crystals.

e. Solution.—If that part of the tube containing the crystalline deposit be heated in a test tube with water the deposit will dissolve. With this solution the liquid tests may be made as follows:—

Liquid Tests.—a. If to the solution a few drops of nitrate of silver are added, and then very dilute ammonia, drop by drop, the characteristic yellow precipitate of arsenite of silver will be produced.

b. Treated with solution of sulphate of copper and

ammonia, added as above, a grass-green precipitate of arsenite of copper will be produced.

c. Treated with chlorhydric acid, and then strong sulphydric acid water be added, a precipitate of the yellow sulphide of arsenic is produced, soluble in ammonia.

d. If a small mass of the crystals (see *d*) be boiled with nitric acid, arsenic acid is produced, which gives, with nitrate of silver and ammonia added as above, a reddish-brown precipitate of arsenite of silver.

It is evident that the various tests given in this section may be made from the deposits produced in Marsh's and Fresenius' and Babo's apparatus.

Which and how many of the tests enumerated are to be made, must depend upon the quantity of arsenic found. In most cases, as has been said if discovered, there is sufficient present, with careful manipulation, to make them all.

7. Preservation of the Tests.—It is considered of importance by medical jurists that specimens of the poison obtained in the course of the examination of a medico-legal case be preserved, that they may be shown to the court if a trial occurs. In certain cases, as in those where metallic poisons have been discovered, this may readily be done. I have been in the habit, for a considerable time, in such cases, especially where arsenic has been found to be the toxical agent, to attach the slips of porcelain and the glass tubes containing the various tests to a sheet of cardboard, and inserting this in a frame (protected by a plate of glass).

In the upper part is mentioned the name of the party submitted to toxical examination; immediately below, the age and date of death, and the date of the commencement and completion of the examination; below these, in the centre, are placed the specimens; upon the right, opposite each, are stated the nature of the substances exhibited; upon the left are the names of the parts or of the materials found to contain the poison, indicating by letters the specimens obtained from each.

By this arrangement, the various results are placed in a secure and permanent form which may readily be inspected. The collection itself gives at a glance an epitome of the chemical examination.

As regards the mode of preserving the specimens, it may simply be said that the tubes containing the mirrors from Marsh's and Fresenius' and Babo's apparatus are drawn out to a point at either end, and sealed by a blowpipe, the deposits being in the centre; the same with the other solid tests. The liquid tests may be formed in tubes of the proper form by the successive introduction of the proper reagents, or they may be placed there after being formed in another vessel by simply heating such a tube and immediately immersing its open end into the liquid containing the precipitate, leaving it there till it cools; a portion of the precipitate and liquid will rise in it, when the open end is to be sealed. The tubes are then to be attached by wires or cords to the cardboard, and the proper names attached as already mentioned.

Preparation of Caustic Soda from Nitrate of Soda.—Wöhler has found (*Annalen der Chemie und Pharmacie*, bd. cxix. s. 375) that when a mixture of peroxide of manganese and nitrate of soda is calcined in a close vessel, no manganate of soda is formed. He believes that the nitrate is decomposed at a lower temperature than that necessary to form manganic acid. The decomposition is so complete that the process may be employed to produce caustic soda.

PHYSICAL SCIENCE.

Note on the History of the Dynamical Theory of Heat, by* J. P. Joule, *LL.D., F.R.S.*

Will you permit me to trouble your readers with a few remarks on the subject of my friend Professor Tyndall's lecture at the Royal Institution, reported in your last Number.† In this lecture he enforces the claims of M. Mayer, a philosopher whose merit has perhaps been overlooked by some of our English physicists, and, unaccountably so, by his fellow-countrymen. I myself was only imperfectly acquainted with his papers when, in good conscience and with the materials at command, I gave a sketch of the history of the dynamical theory of heat, in my paper published in the *Philosophical Transactions* for 1850. M. Mayer's merit consists in having announced, apparently without knowledge of what had been done before, the true theory of heat. This is no small merit, and I am the last person who would wish to detract from it. But to give to Mayer, or, indeed, to any single individual, the undivided praise of propounding the dynamical theory of heat, is manifestly unjust to the numerous contributors to that great step in physical science. Two centuries ago, Locke said that, "Heat is a very brisk agitation of the insensible parts of the object, which produces in us that sensation from whence we denominate the object hot; so that what in our sensation is *heat*, in the object is nothing but *motion*." In 1798, Rumford, inquiring into the source of heat developed in the boring of cannon, observed that it was "extremely difficult, if not quite impossible, to form any distinct idea of anything capable of being excited and communicated, in the manner the heat was excited and communicated in these experiments, except it be motion." In 1812, Davy wrote:—"The immediate cause of the phenomena of heat, then, is motion, and the laws of its communication are precisely the same as the laws of the communication of motion;‡ and he confirmed his views by that original and most interesting experiment in which he melted ice by friction. In 1839, Séguin published a work entitled "De l'Influence des Chemins de Fer." He shows that the theory generally adopted would lead to the absurd conclusion that a finite quantity of heat can produce an indefinite quantity of mechanical action, and remarks (p. 328):—"Il me paraît plus naturel de supposer qu'une certaine quantité de calorique disparaît dans l'acte même de la production de la force ou puissance mécanique, et réciproquement." At p. 383 he remarks:—"La force mécanique qui apparaît pendant l'abaissement de température d'un gaz comme de tout autre corps qui se dilate, est la mesure et la représentation de cette diminution de chaleur." In p. 389 he gives a table of the quantity of mechanical effect produced corresponding to the loss of temperature of steam on expanding. From this it appears that 1° C. corresponds with 363 kilogrammes raised to the height of 1 mètre. At p. 403 he states:—"Je bornerai là mes réflexions sur un sujet dont chacun saura apprécier l'importance. Du calorique qui est employé par l'industrie à produire de la force, et aux usages domestiques, une faible partie seulement est utilisée; une autre quantité bien plus considérable, et qui pourrait suffire à créer d'immenses valeurs et à augmenter d'autant la richesse nationale, se

* In a letter to the Editors of *The Philosophical Magazine and Journal.*

† Chemical News, vol. vi. p. 23.

‡ "Elements of Chemical Philosophy," p. 49.

trouve absolument perdue." From the above extracts it will be seen that a great advance had been made before Mayer wrote his paper in 1842. Mayer discourses to the same effect as Séguin, but at greater length, with greater perspicuity, and with more copiousness of illustration. He adopts the same hypothesis as the latter philosopher,—viz., that the heat evolved on compressing an elastic fluid is exactly the equivalent of the compressing force, and thus arrives at the same equivalent,—namely, 365 kilogrammes per 1° C.

It must be remarked that, at the time Séguin and Mayer wrote, there were no known facts to warrant the hypothesis they adopted. There was no reason to assert that the heat evolved by compressing a gas was even approximately the equivalent of the compressing force. This being the case may account for the inattention of the scientific world to these writings. The dynamical theory of heat certainly was not established by Séguin and Mayer. To do this required experiment; and I, therefore, fearlessly assert my right to the position which has been generally accorded to me by my fellow-physicists as having been the first to give a decided proof of the correctness of this theory.

In saying this I do not wish to claim any monopoly of merit. Even if Rumford, Mayer, and Séguin had not produced their works, justice would still compel me to share with Thomson, Rankine, Helmholtz, Holtzman, Clausius and others, whose labours have not only given developments and applications of the dynamical theory which entitle them to merit as well as their predecessors in these inquiries, but who have contributed most essentially in supporting it by new proofs.

Permit me to remark, in conclusion, that I applied the dynamical theory to vital processes in 1843,§ and that in 1847, in a popular lecture published in the *Manchester Courier*, I explained the phenomena of shooting-stars, and also stated that the effect of the earth falling into the sun would be to increase the temperature of that luminary.‖ Since that time Thomson, by his profound investigations, has made the dynamical theory of heat as applied to cosmical phenomena, his own.

I sincerely trust that, by the foregoing remarks, I have done no injustice to Mayer, especially as I grieve to hear that sickness has removed him (I hope for only a short time) from the science to which he has contributed with so much ability. The reproduction of some of his papers in the *Philosophical Magazine*, particularly that "On the Forces of Inorganic Nature," would, I am sure, interest many of your readers, and enable them to fully appreciate his just claims.

On an Electric Light Regulator, by M. Serrin.

The electric light is quite a modern discovery. About the year 1730, when it was first observed in England, it was possible to obtain only a few phosphorescent gleams. In France, in Dufay's hands, these gleams became sparks darting from the body and face of an electrified person. These sparks then shone brighter in the Leyden jar, and as the machines became more perfect, gradually developed into two great discoveries of the age,—the voltaic pile and electro-magnetic action; so that by means of electricity we now obtain the most dazzling light and the intensest degree of heat. Hardly thirty years since the luminous and calorific effects of powerful batteries were first studied, and contrivances are already devised for the purpose of rendering these effects continuous and constant. M. Serrin's regulator, which we propose to describe, is one of the latest inventions, and is distinguished by new and ingenious solutions of the chief difficulty of the problem.

Before describing the mechanism which gives a distinctive character to M. Serrin's regulator, let us briefly indicate the general conditions which a regulator of the electric light ought to fulfil.

There must be a pile having at least 50 Bunsen's elements of ordinary size to produce a good light. 100 elements united in tension give a more brilliant light; but this, again, is far surpassed by arranging them in two batteries each of 50 elements, so as to produce quantity.

It is well known that the current produced by such batteries is in some degree like the lightning's stroke, and that there is real danger in closing the circuit by touching the positive pole with one hand and the negative pole with the other. Nevertheless, this energetic power, incessantly reproduced, manifests its presence by no external sign, whilst it is propagated through a circle formed of thick metallic wires. It shows itself with violence only on closing and breaking the circuit. If sharply closed, only a bright light is seen; if the circuit be suddenly broken, a bright light is also visible, generally of a different aspect; but if the two wires, or rather the two bodies which should complete the circuit, are made to approach each other, so that the circuit, precisely speaking, is neither wholly open nor wholly closed, then the double phenomenon becomes permanent and the light extremely brilliant. No matter can resist this heat incessantly renewed, which is maintained as long as the action of the pile lasts; that is to say, for days together.

Thick rods of gold, iron, and platinum melt like sealing-wax, and their vapours give various colours to the luminous envelopes which seem to unite the two poles. Silica, alumina, and the greater number of the most refractory substances, taken separately, are alike fused and volatilised. There is, however, one substance,—the only one, perhaps,—which in some degree resists the action of this furnace, and which, by a conjunction of favourable circumstances, is a good conductor of electricity, a condition indispensable to the object in view, can be fashioned in any form, and is, moreover, neither rare nor dear. This body is charcoal, such as concretes in gas retorts, or which can be prepared in pieces by particular processes. Round or square perfectly even rods are made of it, about 30 centimètres long, and varying in thickness from 5 to 10 or 12 millimètres. Two of these rods are adapted at one of their extremities to suitable metallic pieces, one terminating the positive wire, the other the negative wire of the pile. These wires of good red copper, from 3 to 4 millimètres in diameter, covered with silk or cotton, may be several hundred mètres, or even several kilomètres long, according to the distance between the pile and the extremities of the wire. The positive and negative charcoals are generally superposed vertically. Were their free extremities planed and placed in perfect contact, the current introduced by means of the commutator would not manifest itself. It would pass into the charcoal as into the copper wire, without giving any outward sign of its presence. The circle would be completely closed.

But if in the apparatus or regulator containing the charcoals there is an electro-magnet provided with a movable armature conveniently disposed, the passage of the current would cause the armature to fall, and this

§ *Philosophical Magazine*, S. 3, vol. xxiii. p. 442.

‖ *Ibid*, vol. xxxii. p. 350; and *Manchester Courier*, May 12, 1847.

movement communicating itself, for instance, to the supporter of the lower charcoal, would depress it from 2 to 3 millimètres, whilst the supporter of the upper charcoal remains fixed. It is clear that the free extremities of the charcoal being no longer in contact, the circuit will be broken, light will burst forth, and that the phenomenon will persist under the single condition that the circuit is neither completely closed nor broken; that is to say, beyond the limits which the current can traverse.

The better to appreciate other phenomena, let us now carefully examine the effects produced on the charcoals.

Charcoal resists fusion, but it is acted on by a kind of molecular disintegration, which rapidly wastes it, the result either of the simple action of the intense heat or the current itself, which tears off and transforms the last material particles. The wear is unequal, that at the positive being generally about twice as great as that at the negative. The combustion of charcoal by the oxygen of the air is of little account, for no marked difference is observable when the charcoals are kept in an atmosphere of nitrogen. It will be observed that the incandescence of the positive pole occupies more length than that of the negative, as if the latter underwent a less degree of heat. In consequence of this destructive process, the space between the two charcoals becomes in a few minutes enlarged. At first only 2 or 3 millimètres, the distance soon increases to 8, 10, or even more, according to the nature of the charcoal and the force of the current.

To observe these phenomena to the greatest advantage, we must project on to a screen the image of the charcoals magnified 8 or 10 times, when the light becomes supportable, so that observers can study with facility the series of appearances which present themselves in this focus of light and heat, apparently so constant, yet so agitated. We cannot now enter into the details of the curious observations which have been made on the impurity of charcoals, on the coloration of the flames by the substances introduced into them, on the fusion of bodies placed, not in contact with the charcoals, but in the intervening space. We will confine ourselves to stating that the intensity of the light is notably diminished by a kind of waster, which forms from time to time on the point of the negative charcoal by the accumulation of particles from the positive charcoal, as if by the current. These wasters disappear and reappear at intervals, but they are very rarely observed with certain charcoals and at certain degrees of intensity of the pile. Consequently, careful selection of the charcoal must be made in order to secure a more constant light.

The interval between the positive and negative extremities cannot be indefinitely increased in the regulator, and for two reasons:—1. The intensity of the current diminishes in proportion to the extent of this interval. 2. The intensity of the light diminishes with the force of the current. It is necessary, then, to limit the increase of the space to prevent the diminution of the light. This is one of the most important and one of the most delicate functions of the regulator; and for this purpose M. Serrin's mechanism is unrivalled in ingenuity. It is evident that the electro-magnet previously mentioned is the regulator of the motive power to coadapt the charcoal; but this adaptation is a very complex process. 1. The centre of the focus of light must remain at the same level. 2. The charcoals must not come into contact, as the circuit would then be completely closed and the light extinguished, at least for a moment. 3. The movement must be made exactly at the right instant; that is to say, before the current has undergone a certain, hardly perceptible, diminution.

It is especially in accomplishing the last condition that M. Serrin's regulator acts with unequalled precision.

The armature of the electro-magnet can be likened to the scale of a balance with a fixed weight, of which the balancing space is limited to 3 or 4 millimètres by tangent screws, and which, instead of having counter weights on the other side, are supported by two springs, one fixed nearly in equilibrium, while the other receives a variable tension by a movement of the screw. Such a scale is easily made to descend by the superaddition of 10, 20, or 30 grammes, according to the degree of tension to be given to the second spring. Such is the principle on which M. Serrin has formed his ingenious apparatus. His armature is connected with all the supports of the negative charcoal, and oscillating vertically and freely within the narrow limits of 3 or 4 millimètres, the two springs keep it raised, and the superaddition making it descend is the attractive force of the electro-magnet. This force decreases with the force of the current; consequently it decreases when the charcoals, from being worn away, leave too great a space between them, and the light begins to fade.

The variable tension of the spring is, in fact, regulated by this datum. The instant this minimum is reached the scale ascends; that is to say, the spring raises the armature, the surcharge due to the electro-magnetic force having become insufficient to restrain it.

These improvements seem to us all the more important since M. Serrin, in constructing his regulator, has succeeded in uniting the freedom and accuracy of the automatic movements with a solidity which excludes all accidental causes of derangement.

We have proved that this apparatus is not less fitted to receive the induced current proceeding from powerful magneto-electric batteries, set in motion by a steam-engine of three or four horse power. In this case, the current is not continuous, but alternately positive and negative. There is no need of much complication in these batteries to rectify the current, leaving it in its original uncontinuous state; but in this case rectification is useless, the regulator adapting itself perfectly to the disconnectedness and to the alternation.—*Comptes-Rendus.*

INTERNATIONAL EXHIBITION.

Class I.

Mining, Quarrying, Metallurgy, and Mineral Products.

(*Continued from page* 89.)

The display of the Swansea Local Committee (346) is worthy of the highest commendation, and deserves a careful study by all interested in mineralogy and metallurgy. The Committee exhibit carefully-selected specimens of all the ores, Cornish, foreign, and colonial, which are carried to Swansea for smelting. They are mainly ores of copper and zinc, but there are a few specimens of silver ore. Some of the Spanish zinc minerals shown—the hydrated and anhydrous carbonate—are of great beauty. Ordinary calamine and blende, too, are exhibited in abundance. The collection of Australian and Spanish copper ores is also very good and complete, as is the series illustrative of the process, or rather processes, employed for smelting copper. The latter we need not here describe. The products of the Mona Mine Company (231) are also of some interest.

The minerals consist principally of sulphides of copper, zinc, and iron, and a fine mass of sulphur obtained in calcining the ores is exhibited. Malachite of considerable beauty and richness is displayed by the Schull Bay Copper Mining Company (317); and some of the rare crystallised oxide of copper is shown by Mr. Secombe (320). The specimen of Devonshire copper ores exhibited by the Tavistock Committee (349) and the Devon Great Consols Mine Company (87) present no features of particular scientific interest, great as is their value in other respects.

The Messrs. Courage have a case (69) illustrating the manufacture of zinc from calamine and blende, which, among other things of some interest, contains good specimens of zinc crystals.

The preparation of white arsenic from mundic is illustrated in a case (93) exhibited by the East Cornwall Mining Company, and also in some fine specimens shown by Messrs. Jennings and Co. (169). Cobalt and nickel are shown by Messrs. Evans and Askin (100), and from the Hafod Isha Works. There are fine ingots of the metals, and in one case an attempt is made to illustrate the method of separating, by several precipitations, the nickel, cobalt, copper, iron, and arsenic which are found associated in the mineral.

The magnificent collection of British minerals exhibited by Mr. Gregory (131) naturally attracts much notice, from the great beauty of some of the specimens. We pass it for the present, to notice the case exhibited by the same gentleman in Class 29. It is possible that some of our readers, and perhaps those who have been oftenest to the Exhibition, have never yet found their way to the Central Tower, in which Class 29 is located. We recommend them, however, to make their way thither on the earliest opportunity. The collections of Mr. Gregory (5597) and of Mr. Wright (5618) will well reward the visitor for the exertions he has made to reach the spot. Besides the "elementary collections," which alone are mentioned in the Catalogue, he will find in these cases specimens of rare beauty and of great value. The case of Mr. Wright contains two or three tolerably perfect crystals of that very rare mineral—cromfordite, chloro-carbonate of lead, and some large Siberian emeralds. There are also some fine specimens of beryl and topazes, and a large mass of crystallised apatite. Mr. Gregory's case contains a beautiful specimen of fibrous malachite, a large crystal of rutile, some arragonite, of great beauty, and a fine piece of iron-glance. These two cases do their respective exhibitors the highest credit for knowledge and enterprise. The elementary collections for educational purposes are very well selected and very cheap. Mr. Highley's collections are no less deserving of notice. This gentleman has made great efforts to promote the cause of scientific education, and his exertions have been duly appreciated by the Juries of this Exhibition. His cases in this department will be looked at with great interest. They contain minerals,—some of great beauty, and all well selected for educational purposes,—and models of crystals, which will be found of great assistance in acquiring a knowlege of crystallography. Mr. Statham has also done much to excite a love for chemical study in the juvenile mind, by the little cabinets of marvellous cheapness which he exhibits in Case 5612. Parents who wish to provide their sons with winter amusements which may perhaps have great influence in directing their minds to pursuits which are always of interest and sometimes of great value and profit, could not do better than purchase for them one of these cabinets. Advanced chemists will also find things in the case which may at times be of use to them. The portable laboratories seem very complete, and a pocket blowpipe-case will prove highly serviceable to the mineralogist on a summer tramp. The toxicological chest, for medical practitioners, appears to contain all that is necessary for the pursuit of poisons. All the cabinets are arranged with great skill, and deserve great praise. In Case 5598 Mr. Griffin displays a large quantity of the chemical and philosophical apparatus for which he is now famous.

(To be continued.)

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

1939. William Armand Gilbee, South Street, Finsbury, London, "An improved manufacture of blue colouring matter."—A communication from Messrs. Prosper, Monnet, and Henry Dury, Lyons, France.—Petitions recorded July 3, 1862.

1977. Hermann Eschwege, Mincing Lane, London, "Improvements in purifying wood and other vinegar."

1043. William Edward Gedge, Wellington Street, Strand, London, "An improved lamp for lighting mines."—A communication from Alphonse Dumas, Passage des Petites Ecuries, Paris.—Petition recorded April 11, 1862.

2050. William Gossage, Widnes, Lancashire, "An improved method of, and apparatus for, decomposing chloride of sodium and chloride of potassium, for the production of compounds of soda and potassa."—Petition recorded July 18, 1862.

2112. James Anderson, Allan Bank, near Braco, Perthshire, N.B., "Improvements in separating gluten from starch, and in preparing gluten for food."

2136. Alfred Noble, Bristol, Gloucestershire, "Improvements in obtaining and treating compounds of alumina."

2148. Edward Thomas Hughes, Chancery Lane, London, "An improved process of refining the slag from blast, puddling, and other furnaces, and the employment of the refined material for mortar, stones, slabs, ornaments, and other similar articles."—A communication from Emil Langen, Siegburg, Prussia.

2164. George Henry Birkbeck, Southampton Buildings, Chancery Lane, London, "Improvements in the means or processes employed for preserving timber from decay or destruction."—A communication from George Huwitz, Copenhagen, Denmark.

2174. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of fluids suitable for burning in lamps and for other uses."—A communication from Charles Tyler, Buffalo, Erie, New York, United States.—Petition recorded July 31, 1862,

Notices to Proceed.

787. James Fawcett, Wakefield, Yorkshire, "Improvements in the manufacture of soap, particularly applicable to the scouring, cleansing, and fulling of woollen or other cloths."—Petition recorded March 21, 1862.

814, John Topham, Nottingham, "Improvements in apparatus used for cleansing out the scum and removing the sediment from the water in steam boilers, and preventing incrustation therein."

880. William Paterson, Glasgow, Lanarkshire, N.B., "Improvements in the manufacture of iodine."

714. Constantine Nicolaus Kottula, Bell Isle, London, "Improvements in the manufacture of combined soaps."

724. James Robey, Hereford Road North, London, "Improvements in the manufacturing and refining sugar, and in apparatus employed therein."

936. William Clark, Chancery Lane, London, "Improvements in the manufacture of carbonic acid."—A communication from Louis Joseph Frederic Margueritte and Alfred Laluël de Sourdeval, Boulevart St. Martin, Paris.—Petitions recorded April 2, 1862.

1757. Abram Longbottom, Hammersmith, Middlesex, "Improvements in the manufacture of artificial stone."—Petition recorded June 13, 1862.

1857. Edward Chambers Nicholson, Atlas Works, Lock's Fields, Surrey, "Improvements in the preparation of colouring matters applicable to dyeing and printing."—Petition recorded June 24, 1862.

760. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of barytes and barytic products, and the application of these substances in the manufacture of sugar and other uses."—A communication from Alfred Delaune, Paris.—Petitions recorded March 18, 1862.

780. William Clark, Chancery Lane, London, "Improvements in the manufacture of soap."—A communication from Antoine Auguste Mollard, Boulevart St. Martin, Paris.—Petitions recorded March 20, 1862.

842. Alfred Vincent Newton, Chancery Lane, London, "An improved process of, and apparatus for, separating the fibres of wood, flax, hemp, and other vegetable substances, and extracting the colouring matter therefrom."—A communication from Azel Storrs Lyman, New York, U.S.

876. Charles Henry Townsend, James Young, and James Hankins, Bristol, "An improved method of removing and preventing incrustation in steam boilers."—Petition recorded March 29, 1862.

1127. Charles Denton Abel, Southampton Buildings, Chancery Lane, London, "Improvements in the manufacture and production of certain alloys containing cadmium."—A communication from Henri Catherine Camille de Ruolz and Anselme Louis Marie Fontenay, Paris.—Petition recorded April 17, 1862.

1466. Jean Pierre Jouvin, Rochefort-sur-Mer, France, "An improved process for preserving iron-plated and other vessels and metallic articles from oxidation, and preventing ships' bottoms from fouling."—Petitions recorded May 15, 1862.

1891. Alexander Angus Croll, Coleman Street, London, "Improvements in the treatment of ammoniacal liquor of gas-works."—Petitions recorded June 27, 1862.

948. Alexander Mann, Tottenham, Middlesex, "Improvements in photographic apparatus."

1014. John Langston, North Street, Strood, Kent, "Improvements in the manufacture of Portland cement."—Petitions recorded April 9, 1862.

1601. James Fortescue Harrison, Cambridge Square, Hyde Park, London, "Improvements in preserving the bottoms of ships from the attacks of barnacles and other incrustations."—Petition recorded May 28, 1862.

2050. William Gossage, Widnes, Lancashire, "An improved method of, and apparatus for, decomposing chloride of sodium and chloride of potassium for the production of compounds of soda and potassa."

CORRESPONDENCE.

The Jury Awards.

To the Editor of the Chemical News.

Sir,—We notice in the Chemical News of August 2, in the list of Jury Awards in Class II., the omission of our names, which is explained by the following letter from Professor Lyon Playfair. By publishing it in your widely-circulated Journal you will much oblige us.

We are, &c.

Muspratt Bros. and Huntley.

New Hall, 41, Old Hall Street, Liverpool, August 6.

"Jury Office, 13, Cromwell Road.

"In the first edition of the Book of Awards, by a mistake of the Register Clerk, not seen by the Deputy Commission, the three firms of Muspratt have been omitted. This mistake will be rectified in the second edition, which comes out in a week. You must, therefore, accept the awards as made. The terms of them are appended.

"Signed, Lyon Playfair."

"Muspratt Bros. and Huntley, James Muspratt and Sons, Frederic Muspratt, for soda, chloride of lime, sulphate of alumina. Samples of very fine products, illustrating the manufacture of soda."

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Preparation of Iodides of the Alkalies.—We gave some account of Liebig's new process for the preparation of iodides of the alkalies in a paper read by Dr. Squire, at a Pharmaceutical Meeting (see Chemical News, vol. v p. 205.) The following is the method Liebig adopts for preparing the mixture of phosphoric and hydriodic acids:—(*Amal. der Chem. und Pharm.*, bd. cxxi. s. 222.) He rubs together a mixture of amorphous phosphorus and iodine under a small quantity of hot water. The two bodies almost completely disappear after a short time, forming the two acids which are dissolved by the water. The acids, poured away from any excess of phosphorus, are then saturated with milk of lime, and the soluble iodide of calcium is filtered from the phosphate of lime. The alkaline iodides are then produced by double decomposition, as described in Dr. Squire's paper.

Hydride of Iron.—Wanklyn and Carius have discovered (*Ann. der Chem. und Pharm.*, bd. cxx. s. 69) that when ferrous iodide reacts on zinc ethyl, iodide of zinc, ethylene gas, and hydride of iron are formed. They prepare the ferrous iodide by heating iron filings to redness in a porcelain crucible, and throwing in iodine, first in small quantities to prevent the oxidation of the metal, and in larger quantities when a red heat is reached. The combination only takes place at red heat, at which temperature a periodide appears to be formed, for the fused mass gives off vapours of iodide as it cools. When quite cold a grey lamellar mass of pure ferrous iodide is left. When zinc ethyl, diluted with an equal volume of ether, and this ferrous iodine are placed in a tube under a layer of ether, a large quantity of gas is evolved which appears to be a mixture of ethylene, hydride of ethyl, and hydrogen. The matter left in the tube, after having been well washed with ether, has the following characters: it is a black powder resembling metallic iron, and it gives off pure hydrogen when gently heated. It will keep unchanged if protected from moisture, but, on coming in contact with water, it immediately gives off hydrogen, and forms ferrous oxide. Hydrochloric acid decomposes the hydride of iron, giving off hydrogen and forming ferrous chloride. The authors proved that this hydrogen came at once from the acid and the hydride. They have not determined the exact composition of the hydride.

II. ORGANIC CHEMISTRY.

Action of Chloride of Zinc on Anhydrous Acetic Acid.—Bauer observed (*Journal für Prakt. Chemie*, bd. lxxxiv. s. 288) that when fused chloride of zinc in powder was heated in a closed vessel with anhydrous acetic acid, the latter was changed into water, hydrated acetic acid, and a brownish-black pulverulent matter (apparently belonging to the class of humic bodies described by Mulder) having the formula C_4H_2O, or a multiple of these numbers. Monohydrated acetic acid underwent no change when treated in the same way.

Action of Nascent Hydrogen on Cinnamic Acid.—Cinnamic acid is decomposed by sodium amalgam in the presence of water, and on adding hydrochloric acid to th

liquid obtained colourless drops separate, which presently solidify. Analysis of this body showed it to have the formula $C_9H_{12}O_2$. The authors (Erlenmeyer and Alexeyeff, *Annal. der Chemie und Pharm.*, bd. cxxi. s. 375) are disposed to consider this a homologue of the terebinthylic acid, $C_8H_{10}O_2$, obtained by Personne by acting on hydrated oil of turpentine with soda lime.

Compounds of Xanthic Acid.—Hlasiwetz prepares metallic xanthates by decomposing an alkaline xanthate by the chlorides of the metals in the presence of sulphide of carbon. The metallic xanthates are soluble in this liquid, while the chloride of the alkali is precipitated. On evaporating the sulphide of carbon the xanthates remain. These are soluble in alcohol and ether, but are slowly decomposed. The formula of xanthic acid the author writes:—

$$H \left\{ \begin{matrix} (C\,O)'' \\ (C_2H_5)' \end{matrix} \right\} S_2$$

The salts of arsenic, antimony, bismuth, *ferricum* and chromium are represented by the above formula tripled, the H_3 being replaced by one of these metals: thus,—$3\,(C\,O)''$, $M_3\,(C_2\,H_5)'_3$, S_6. The salts of tin, mercury, cobalt, and nickel are represented by the formula of xanthic acid, the H being replaced by the metal. All the salts yield beautiful crystals, belonging for the most part to the monoclinic system, the salt of ferricum belonging to the triclinic. The xanthates of arsenic, antimony, and iron are very soluble in cold sulphide of carbon; those of nickel, cobalt, and chromium only dissolve in the warm; while those of tin and mercury require long boiling for their solution, and are quickly deposited in a crystalline state.

MISCELLANEOUS.

The Jury Awards.—The following circular has been issued by the Society of Arts:—"The Council of the Society of Arts have decided to invite the opinion of the Jurors, the Commissioners for the Colonies and for Foreign Countries, and the principal exhibitors at the International Exhibition, on the question of Awards of Merit in connection with International Exhibitions; and I am directed by the Council of the Society of Arts to transmit to you the accompanying queries, with a request that you will favour them with your views on the subject, it being the intention of the Council to embody the answers they may receive in a public report:—1. Are you of opinion that awards for merit, by medals or otherwise, in the International Exhibitions, are desirable? 2. State the reasons for your opinion. 3. Ought works of fine art and designs to be excluded from the awards? 4. Can you suggest any better method than the appointment of Jurors for making the awards? 5. Can you suggest any improvement in the constitution or proceedings of the Juries? 6. Is any appeal from the decision of Juries desirable? 7. If you think awards undesirable, can you suggest any other means by which meritorious productions may be brought to the notice of the public? 8. Have you any further suggestions to offer on the subject? It is particularly requested that any replies with which you may favour the Council may be sent not later than the 15th of September, and that they may be written on foolscap paper, on one side only, with an inch margin, and numbered corresponding to the number of the questions."

Combustibility of Petroleum.—Much discussion and diversity of opinion having recently obtained in Liverpool, regarding the risk of storing the petroleum now arriving there, some experiments were recently made with a view to test the inflammability of the liquid. The experiments, undertaken at the instance of the Watch Committee of the Corporation, were superintended by Major Greig, the head constable. Five thirty-gallon barrels of crude petroleum, or rock oil from Canada, and also from Philadelphia, were burnt under different circumstances. In every case the combustion was rapid and fierce. In two of the experiments, made in a confined chamber built for the purpose, Phillips's fire annihilators extinguished the fire in a few minutes. In another, in the same chamber, water, thrown on the burning mass by two hose, extinguished the fire with considerable rapidity. Two barrels were ignited in the open air, one after the other. In the first a fire annihilator, which was brought to bear on it partially, was thrown out of the conductor's hand, he himself was knocked down, and many of the crowd were overthrown in their anxiety to escape from the supposed danger. The water hose were then brought to bear on the burning mass, and they soon overcame the flames, which were afterwards several times re-kindled and re-extinguished. So far as the experiments referred to can be held to be a criterion, petroleum seems to burn in much the same manner as to intensity and rapidity as turpentine, to which, in combustion, it bears a strong resemblance, and not to be much more combustible than whisky, rum, or brandy. As few, if any, of the ordinary conditions of a fire were present at these experiments, it is a matter of doubt how far they establish any theory which has been propounded for or against rock oil as a dangerous article, or, at all events, as a more dangerous article of commerce than several others which we are in the habit of storing and using daily.—*Engineer.*

On a Powerful Fulminant.—When equal parts of finely-powdered chlorate of potash and red prussiate of potash are very carefully mixed on paper with a bone spatula, a treacherously powerful fulminant is formed, which explodes with the slightest friction and percussion, and if nineteen be the sum of their united elements they will be ultimately arranged as follow:—

$Cy_3 + O_3$ = Fulminic acid.
$Fe_2 + Cy_3$ = Sesquicyanide of iron.
$K_3 + O_3$ = Potassa.
$K + Cl$ = Chloride of potassium.

A much better fulminant, however, is made when three parts of ferridcyanide and four of chlorate are used. A few grains placed on a piece of sand-paper, and smartly rubbed with the end of a small phial or other blunt instrument, produces a most deafening explosion. As I am now on the subject of explosives, I refer to a discussion which took place about twelve months since in the Chemical News, between J. M. C. and Mr. Hudson, relative to the explosibility of white gunpowder by friction, and I do so more with the view of cautioning others than provoking further discussion. J. M. C. says it is exploded by friction, and cites the case of Mr. Hudson's assistant, who nearly lost his sight through it, whilst Mr. Hudson contends it is not so. All I can say is, that yesterday, in the presence of my pupils and a captain of the navy, I mixed six grains of chlorate of potash with two grains of ferridcyanide of potassium and one grain of sugar of milk, on paper, and then introduced a few grains into a mortar, when, with one turn of the pestle (a Wedgwood-ware one), it all exploded, so that J. M. C. is right about its dangerous properties. On a former occasion I nearly lost my own eyesight by such an explosion. All compounds of chlorate of potash are liable to it, even when no nitrogen is present—as powdered galls and chlorate for instance.—*John Horsley, F.C.S.*

ANSWERS TO CORRESPONDENTS.

F. Milthorp.—Ure's Dictionary will give you the desired information.

Value of the Kilogramme.—*D. R.* writes to ask what the weight called a kilogramme ought to represent, the weight of a litre of water *in vacuo* or in air? We can find no information on this subject in works professing to treat on weights and measures. The tables forwarded by our correspondent are very elaborate, and would be of great use to scientific men if reliable. Will they be published?

A Reader.—1. We do not know where they were first published. 2. Reports of the Royal College of Chemistry.

THE CHEMICAL NEWS.

VOL. VI. No. 143.—August 30, 1862.

PREPARATION OF ALCOHOL FROM COAL GAS.

THE daily and weekly press, whose scientific paragraphs at this season of the year are more calculated to astonish than instruct the public, have lately contained announcements of a discovery to the above effect, at St. Quentin, by a young chemist named Cotelle. The paragraph goes on to state that a Joint-Stock Company, with a capital of 400,000 francs, has been formed to carry out the patent. The inventor announces that he can sell his alcohol at 25 francs the hectolitre, while the most inferior spirit produced from other articles is selling for 75 francs the hectolitre. This, like many other chemical patents, is utterly impracticable on the large scale. M. Cotelle has read that M. Berthelot, some years ago, succeeded in transforming olefiant gas into alcohol by the intervention of sulphuric acid, and has jumped to the conclusion that as coal gas contains a considerable quantity of olefiant gas, he has only to shake it up with sulphuric acid to produce as much alcohol as he likes. We have seen M. Cotelle's patent; in it he claims to produce alcohol of good flavour by means of purified lighting gas passing over (*traversant*) liquid sulphuric acid, or by bringing it in contact with the acid in vapour (*avec l'acide en vapeur*). Our readers who know the long and tedious operation by which even a minute trace of alcohol can be produced in this way, will not envy the shareholders who have subscribed with such wonderful rapidity.

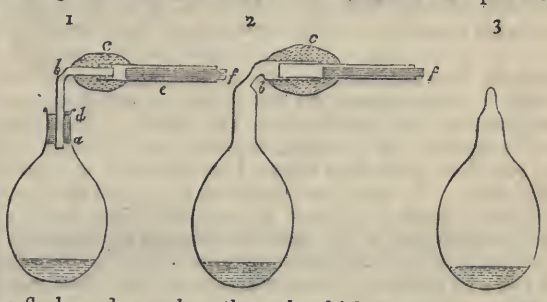
SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Experiments on the Formation of Infusoria in Boiled Solutions of Organic Matter, enclosed in Hermetically Sealed Vessels and Supplied with Pure Air, by JEFFRIES WYMAN, *M.D., Hersey Prof. of Anatomy in Harvard College.*

PASTEUR, in his admirable researches on fermentation, has brought forward experimental evidence to show that this process depends upon the presence of minute organisms in the fermenting fluid, and that the source of all such organisms is the atmosphere. In support of this opinion, he asserts that when a fluid containing organic matter in solution is put into a flask and "boiled two or three minutes," and supplied only with air which has been filtered by passing through a tube heated to redness, and the flask is then hermetically sealed, no fermentation takes place, no organisms are formed, and that the contents remain indefinitely without change. But if the same solution is exposed to the air in its ordinary condition, it becomes filled with various living forms. Out of a large number of experiments prepared in the manner above described, he has not known one to give a different result from that mentioned.* He further states that if the neck of the flask is drawn out into a very slender curved tube of several inches in length, the contents boiled, and then allowed to cool without the end of the tube being closed, so that the air enters at the ordinary temperature and has free access to the interior of the flask, even then no fermentation takes place and no organisms appear. His explanation of this is, that the air which enters first meets with the hot steam, and the spores or organisms contained in it are killed; while those which enter the tube later move more slowly, and are deposited on the moist walls of it without entering the body of the flask.†

In most of the experiments given below the results have been quite different, and living organisms have made their appearance, in some instances, where even greater precautions were taken than those mentioned by Pasteur. In order that the reader may understand what precautions were taken, we shall first describe the manner in which the experiments were performed.

1. In some instances (as in Experiments 1 to 5, 7 to 11, 13 to 15, 29 and 30 inclusive) they were prepared as in Fig. 1. The materials of the infusion were put into



a flask, and a cork *a*, through which was passed a glass tube, drawn to a neck at *b*, was pushed deeply into the mouth of it. The space above the cork was filled with an adhesive cement *d*, composed of resin, wax, and varnish. The glass tube was bent at a right angle, and inserted into an iron tube *e*, and cemented there with plaster of Paris *c*. The iron tube was filled with wires *f*, leaving only very narrow passage ways between them.‡

2. Others (as in Experiments 6, 12, 16 to 24, and 31

* J'affirme avec la plus parfaite sincerité, que jamais il ne m'est arrivée d'avoir une seule experience disposée comme, je le viens de le dire, qui m'ait donné un seul resultat douteux."—*Annales des Sciences Naturelles*, T. xvi. ivme Serie, 1861, p. 33.

† Il semble que l'air ordinaire rentrant avec force dans les premiers moments doit arriver tout brut dans le ballon. Cela est vrais, mais il rencontre un liquide encore voisin de la temperature de l'ebullition. La rentrée de l'air se fait en suite avec plus de lenteur et, lorsque le liquide est assez refroidie pour ne plus pouvoir enlever aux germes leur vitalité, la rentrée de l'air est assez relentée pour q'il abandonne dans les courbures humides du col toutes les poussieres capable d'agir sur les infusions, et d'y determiner des productions organisées."—*Ann. des Sc. Nat.*, 1861, T. xvi. p. 60.

‡ An advantage in preparing the experiment in this way is, that the same flask may be used many times.

to 33 inclusive) were prepared as in Fig. 2, in which the joining at *a*, Fig. 1, is avoided, and the iron tube is cemented directly into the mouth of the flask, the neck of which is drawn out at *b*, to render the sealing of it easy. Otherwise the conditions are the same as in Fig. 1.

3. In other experiments (as in Experiments 24 to 28, and 34 to 38 inclusive) the flask, Fig. 3, was sealed at the ordinary temperature of the room, and submerged during the period of the experiment in boiling water. This was the method followed by Needham and Spallanzani, and has the merit of eliminating all suspicions of error which might be supposed to arise from some imperfections in the joinings.

In the first and second methods the solution in the flask is boiled, and at the same time the iron tube filled with wires is heated to redness. While the contents are boiling the steam formed expels the air from the flask. When the boiling has continued long enough, the heat is withdrawn from beneath the flask, and as the steam condenses the air again enters through the iron tube, the red heat of which is kept up, so that all organisms contained in the air are burned. In both methods the flask is allowed to cool very slowly in order that the entering air may be as long as possible in passing through the iron tubes, and thus the destruction of its organic matters insured. When cold the flasks are sealed at *b*, Figs 1 and 2, with the blowpipe.

In experiments 29 and 30, a glass tube filled with asbestos and platinum sponge was used instead of the iron tube filled with wires.

The time during which the infusions were boiled varied, as will be seen by the records, from fifteen minutes to two hours, and the amount of infusion used was from one-twentieth to one-thirtieth of the whole capacity of the flask, the object being to have the materials exposed to as large a quantity of air as possible.

In the account which follows, especial mention is made, in most instances, of the time of the formation of the "film." This is always the first indication which can be had, without opening the flasks, that minute organisms are developed. It is, in fact, made up entirely of them, as has been proved by repeated examinations with the microscope. It may first be detected in small patches, but soon covers the entire surface, and if the flask is gently moved so as to cause the infusion to change its position, the film adheres to the glass and is left by the liquid. In a few of the experiments no such film was formed.

After the flasks were prepared they were suspended from the walls of a sitting-room near the ceiling, where they were exposed to a temperature of between 70° and 80° F. throughout the day and nearly the same during the night.

Experiment 1.‖ (1.)§ Feb. 3, 1862.—A few grains each of sugar, gelatine, and fine cut hay were introduced into a flask of 500 cub. cent. capacity, 20 cub. cent. of water were added, and the whole thoroughly boiled. A film formed on the surface of the fluid on the eighth day; the flask was opened on the ninth, and found to contain large numbers of Bacteriums.

Experiment 2. (1.) Feb. 3.—This was prepared in the same way as the preceding, excepting that pepper was added to the solution. The flask was opened on the twenty-ninth day, and Bacteriums were found in great numbers.

Experiment 3. (1.) Feb. 4.—A few grains of cheese, sugar, and gelatine were dissolved in 17 c.c. of water, filtered and boiled in a flask of 500 c.c. capacity. A film formed on the nineteenth day; the flask was opened on the thirty-sixth and found to contain Bacteriums.

Experiment 4. (1.) Feb. 4.—Twelve c.c. of a solution like the preceding, with the addition of a small quantity of pepper, was boiled in a flask of 250 c.c. capacity. It was opened on the twentieth day, but no living organisms were found.

Experiment 5. (1.) Feb. 5.—A solution of sugar, gelatine, and cheese was boiled and filtered, and again boiled in the flask, which was opened on the twenty-ninth day, and no organisms detected.

Experiment 6. (2.) Feb. 10.—A solution of gelatine and sugar, to which was added a few drops of urine and milk, were put into a bolt-head, the tube of which had been drawn to a neck, and after boiling was hermetically sealed. The flask was opened on the thirteenth day, and found to contain yeast plants and some very slender filaments, which appeared to be of a vegetable nature.

Experiment 7. (1.) Feb. 10.—Twenty c.c. of a solution like the preceding was boiled in a flask of 875 c.c. capacity. A film formed on the eleventh day, and on the thirtieth the flask was opened and found to contain Vibrios and Bacteriums.

Experiment 8. (1.) Feb. 25.—A solution of sugar and gelatine, to which fragments of green leaves and flesh were added, was boiled 1 hour and 40 minutes. The flask was opened on the fifteenth day; no organisms were found.

Experiment 9. (1.) Feb. 25.—The same as the preceding, without the addition of the flesh. This solution was boiled 40 minutes and opened on the third day. No organisms were found.

Experiment 10. (1.) March 6.—Three flasks, *a b c*, were prepared in the same way, each containing a solution of sugar and gelatine, to which was added a few drops of urine and some fragments of muscle; *a* and *c* were boiled 30 minutes and *b* 1 hour. Air was supplied to *a* and *b* through a heated tube and to *c* at the temperature of the room. A film formed in *a* on the eleventh and in *c* on the twelfth day, and at a later period in *b*. They were all opened a few days afterwards and found to contain Bacteriums, Vibrios, and ferment cells.

Experiment 11. (1.) March 12.—An ounce of meat was suspended in a flask of 850 c.c. capacity with about 40 c.c. of water in it. This was boiled 20 minutes, during which time the meat was exposed to the steam in the flask. The juice which dropped from the meat was coagulated in the water beneath, and the meat itself was thoroughly cooked. On the second day the meat was covered with a gelatinous exudation, and on the third a film was formed on the surface of the water. The flask was opened on the fifth day and found to contain Vibrios, Bacteriums, and a few ferment cells. The gelatinous exudation on the surface of the meat also contained the same organisms, and appeared to be wholly made up of them.

Experiment 12. (2.) March 13.—The juice of an ounce of beef, to which was added 10 c.c. of urine and 40 c.c. of water, was boiled 20 minutes in a bolt-head and hermetically sealed. A film formed on the fourth, and the flask was opened on the eleventh day, when there was a distinct rush of air outwards. Large numbers of Bacteriums were found, also small spherical bodies with ciliary motions and oval bodies like Kolpoda, containing

‖ In the first seven experiments the time which the contents were boiled is not stated, but it was in no instance less than fifteen minutes.

§ The figures in parentheses following the number of the experiment indicates which of the three modes of preparing the experiment was made use of.

what appeared to be Bacteriums. One of these Kolpoda-like bodies moved with cilia.

Experiment 13. (1.) March 15.—An ounce of beef was suspended over water in a flask of 500 c.c. capacity and boiled 25 minutes. The same changes took place as in the preceding experiment. The exudation appeared on the surface of the meat and the film on the water on the second day; on the fourth day the meat fell to pieces; the flask was opened on the ninth day; Bacteriums were found in large numbers, and there was a slight odour of putrefaction.

Experiment 14. (1.) March 17.—Juice of beef and a few shreds of beef were boiled in a flask of 300 c.c. capacity for 20 minutes. A film was formed on the second day, and the flask was opened on the eleventh day. Bacteriums existed in abundance.

Experiment 15. (1.) March 19.—Fifty c.c. of beef were boiled 40 minutes in a flask of 800 c.c. capacity. The film began to form on the second day, and the flask was opened on the twenty-fourth. The film had disappeared, the fluid had a nauseous odour, and the Bacteriums were diffused through the whole mass instead of being mostly confined to the surface, as in the preceding experiments.

Experiments 16, 17, 18, 19. (2.) March 20, were made with juice of beef and water in flasks of 550 c.c. capacity. 16 was boiled 15 minutes, the film formed on the second day, and the flask was opened on the ninth. Vibrios were found in abundance, of different lengths, some of them moving with great rapidity. 17 was boiled 30 minutes, the film was formed on the third, and the flask was opened on the ninth day. Vibrios were found in great numbers, some of them bending and extending themselves rapidly. Some minute spherical bodies were also seen, having the kind of motion which results from vibrating cilia, though none of these were detected. 18 was boiled 15 minutes, the fluid having been previously filtered; the film formed on the third, and the flask was opened on the eighth day; the organisms found were the same as in 17. 19 was boiled one hour. The film formed on the second, and the flask was opened on the twenty-fourth day. The infusion had a slightly putrid odour, and contained Vibrios and Bacteriums.

Experiment 20. (2.) March 22.—The flask and the contents of it were the same as in the experiments just described. The solution was boiled 15 minutes. The film formed on the fifth, and the flask was opened on the thirty-first day. The fluid had become of a dark reddish brown colour, the film had disappeared, and some of the shreds of the coagulated albumen had become nearly black. Bacteriums were found in large numbers, and the darker shreds seemed to be made up of them.

Experiment 21. (2.) March 27.—Beef juice was boiled 40 minutes; the flask was opened on the twenty-fifth day, and found to contain Bacteriums.

Experiment 22. (2.) April 2.—Beef juice and fragments of beef were boiled 15 minutes, and the air was introduced through a much smaller tube. Bacteriums were found on the twentieth day.

Experiment 23 (2), April 5, was prepared in the same way as the preceding experiment. The film formed on the sixth day, and the flask was opened on the seventeenth. The sealed end was melted in the flame of a spirit lamp, when the gas escaped with force. Bacteriums were found.

Experiments 24, 25, 26 (3), were all prepared in the same way, April 16. The capacity of the flasks was 550 c.c.; the contents were beef juice and water 17 c.c., urine 7 c.c. The flasks were folded in a napkin, immersed in water, which was gradually heated to the boiling point, and each then exposed to it for 30 minutes. The film formed in 26 on the fourth day, and in 24 and 25 on the fifth, and were all subsequently found to contain Bacteriums.

Experiments 27, 28. (3.) April 24.—Two flasks, each of 550 c.c. capacity, and each containing about 20 c.c. of beef juice and urine, were hermetically sealed at the temperature of the room, wrapped in cloth, and exposed for two hours to boiling water. The film formed on the fourth day. One of them was opened on the fifth and the other on the eleventh, and both found to contain Bacteriums.

Experiments 29, 30. (1.) Feb. 17.—In both of these the contents of the flasks were solutions of sugar and gelatine in water, to which fragments of cabbage leaves were added. The air was introduced through a Bohemian glass tube, filled with asbestos and platinum sponge, and heated to redness. The materials were boiled 30 minutes. In 29 the film was formed on the twenty-ninth, and the flask was opened on the thirty-ninth day. The solution was found to contain Bacteriums and cells filled with them. In 30 the film was formed on the seventh day, and Bacteriums were found on the twenty-third, when there was a slight odour of putrefaction.

Experiments 31, 32, 33. (2.) March 24.—30 grains of sugar, 20 c.c. of beef juice, 158 c.c. of water, were divided into three parts, and each part put into a flask of 550 c.c. capacity, and boiled 15 minutes. No film was formed in either of them. 33 was opened on the thirtieth day; ferment cells and some filaments of a doubtful vegetable appearance were found. 32 was opened on the forty-second day, and contained ferment cells and monads. An escape of gas took place when the flask was opened. 31 was opened on the forty-third day, and found to contain ferment cells in large numbers, in different stages of cell multiplication. As in 32, there was an escape of gas.

Experiment 34. (3.) March 27.—Juice of mutton, in a hermetically sealed flask, was boiled five minutes in a Papin's digester, under a pressure of two atmospheres. A film formed on the fourth day. It was opened several days later, in the presence of Prof. Gray, and found to contain Vibrios and Bacteriums, some of them moving with great rapidity.

Experiment 35. (3.)—The same as the preceding, and boiled in Papin's digestor ten minutes, and under the pressure of five atmospheres. No film was formed. The flask was opened on the forty-first day. Monads and Vibrios were found, some of the latter moving across the field. No putrefaction; the solution had an alkaline taste.

Experiment 36. (3.) March 28.—Beef juice was filtered and boiled, as in the preceding experiment, 15 minutes, under two atmospheres. Opened on the forty-first day, and no evidence of life was found. When the end of the flask was heated, previously to opening, it collapsed.

Experiment 37. (3.) March 28.—The same as the preceding; boiled 15 minutes, under five atmospheres. Opened on the forty-first day, and no evidence of life was detected.

We have here a series of thirty-three experiments, prepared in different ways, in which solutions of organic matter, some of them previously filtered, have been boiled at the ordinary pressure of the atmosphere for a length of time, varying from fifteen minutes to two hours, and exposed to air purified by heat. In four instances, viz., in Experiments 4, 5, 8, 10, the contents of the flasks were unchanged at the time they were opened; but in all of

the rest Bacteriums, Vibrios, or other organisms appeared. In nearly every instance their presence was indicated, in the early stage of the experiments, by the formation of a film, which took place in some on the second, and in others not until the nineteenth day, and was afterwards proved by a careful examination with the microscope. Prof. Asa Gray witnessed the opening of some of these flasks, and satisfied himself of the presence of infusoria in the contents. Vibrios, Bacteriums, and Spirillums were the most frequently found; and in addition to these, as in Experiments 10, 11, 12, 29, 31, 32, 33, either ferment cells, monads, or Kolpoda-like bodies were seen, some of them having ciliary movements. Those forms which were observed the most frequently are among the lowest, if not the lowest, of all known organisms.

In many instances, a solution like that in the sealed flasks, and boiled for the same length of time, was exposed to the ordinary air of the room in an open flask. Although the same forms were found in the two, they appeared much more rapidly in the open than in closed vessels, and the contents of the former soon became putrid, while those of the others at the time of opening were mostly not, and in a few instances only slightly so.

We have, in addition, four experiments, viz., 34, 35, 36, 37, made under increased pressure, and sealed by the third method; 34 and 36 were boiled 5 minutes and 10 minutes respectively, under two atmospheres, and 35 and 37, under five atmospheres, for 10 minutes and 15 minutes respectively. Evidence of life, consisting of Monads and Vibrios, were found in 34 and 35, but none in the others.

The result of the experiments here described is, that the boiled solutions of organic matter made use of, exposed only to air which has passed through tubes heated to redness, or enclosed with air in hermetically sealed vessels and exposed to boiling water, became the seat of infusorial life.

The experiments which have been described throw but little light on the immediate source from which the organisms in question have been derived. Those who reject the doctrine of spontaneous generation in any of the forms in which it has been brought forward, will ascribe them to spores contained either in the air enclosed in the flask or in the materials of the solution. In support of this view, it may be asserted that it has been proved by the microscopical investigations of Quatrefages, Robin, Pouchet, Pasteur, and others, that the air contains various kinds of organic matter, consisting of minute fragments of dead animals and plants, also the spores of cryptogamous plants, and certain other forms, the appearance of which, as Quatrefages says, suggests that they are eggs. We have made some examinations of our own on this subject, but it would be unnecessary to give the results in detail. We will simply state that we have carefully examined the dust deposited in attics, also that floating in the air collected on plates of glass covered with glycerine, and have found in such dust, in addition to the *débris* of animal and vegetable tissues, which last were by far in the greatest abundance, the spores of Cryptogams, some closely resembling those of Confervoid plants, and with them, but much less frequently, what appeared to be the eggs of some of the invertebrate animals, though we were unable to identify them with those of any particular species. We have also found grains of starch in both kinds of dust examined, to the presence of which Pouchet was the first to call attention. When compared with the whole quantity of dust examined, or even with the whole quantity of organic matter, both eggs and spores may be said to be of rare occurrence. We have not in any instance detected dried animalcules which were resuscitated by moisture; and when the dust has been macerated in water none have appeared until several days afterwards, until after a lapse of time, when they would ordinarily appear in any organic solution.

Those who advocate the theory of spontaneous generation, on the other hand, will doubtless find, in the experiments here recorded, evidence in support of their views. While they admit that spores and minute eggs are disseminated through the air, they assert that no spores or eggs of any kind have been actually proved by experiment to resist the prolonged action of boiling water. As regards Vibrios, Bacteriums, Spirillums, &c., it has not yet been shown that they have spores; the existence of them is simply inferred from analogy. It is certain that Vibrios are killed by being immersed in water the temperature of which does not exceed 200° F. We have found all motion, excepting the Brownian, to cease even at 180° F. We have also proved by several experiments that the spores of common mold are killed both by being exposed to steam and by passing through the heated tube used in the experiments described in this article. If, on the one hand, it is urged that all organisms, in so far as the early history of them is known, are derived from ova, and therefore from analogy, we must ascribe a similar origin to these minute beings whose early history we do not know; it may be urged with equal force, on the other hand, that all ova and spores, in so far as we know anything about them, are destroyed by prolonged boiling; therefore, from analogy we are equally bound to infer that Vibrios, Bacteriums, &c., could not have been derived from ova, since these would all have been destroyed by the conditions to which they have been subjected. The argument from analogy is as strong in the one case as in the other.—*American Journal of Science.*

On Larixinic Acid, a Crystallisable Volatile Principle found in the Bark of the Larch Tree (Pinus Larix, Linn.), by Dr. JOHN STENHOUSE, *F.R.S.*

THE most convenient way of preparing this somewhat singular substance consists in cutting the bark of the larch into small pieces, and then digesting it in water for twenty-four hours, at a temperature of about 80° C. The solution, which has a deep reddish-brown colour, is then poured off on to a second portion of larch bark, and digested as before. The concentrated infusion is then cautiously heated in an open porcelain dish, at the temperature of about 80° C., till it is converted into a syrup. A portion of this syrup is then distilled, either in glass or porcelain retorts, or, what is better than either, in a silver alembic. Iron retorts cannot be employed for this purpose, as the acetic acid which is always produced during distillation, by forming acetate of iron, instantly destroys the larixinic acid, by changing it into a deep purple-coloured liquid. When a silver alembic cannot be procured, a very convenient way of distilling the extract of the larch is to pour it into a large Florence flask, the neck of which is passed obliquely through a cork or bung, which is inserted into a glass condenser. When the flask is cautiously heated on a sand-bath, the larixinic acid comes over with the first portions of the liquid, but becomes more abundant as the distillation proceeds, and usually forms large flat crystals, which condense on the sides and neck of the receiver. The

liquid which is distilled over, and which contains the greater portion of the larixinic acid, should be poured into small flat basins, and cautiously concentrated at about 60° C. When the greater portion of the water has been dissipated, it is advisable, especially in warm weather, to complete the operation by spontaneous evaporation; for unless the concentration of the aqueous solution of larixinic acid is conducted cautiously, the larixinic acid volatilises along with the vapour of water, and is thereby lost. The highly concentrated solution of larixinic acid, obtained in the way just described, on standing, deposits brownish-yellow crystals, which are impure larixinic acid. This is to be pressed between folds of blotting-paper, and again to be crystallised out of a small quantity of water. The larixinic acid may be rendered perfectly pure by subliming it once or twice. This is easily effected by placing the larixinic acid between two watch-glasses, or in any other suitable apparatus, and heating it cautiously on a sand-bath, or even on a water-bath, as the larixinic acid sublimes at the very low temperature of 93° C. The larixinic acid is a proximate principle, which exists ready formed in the larch. This is easily proved by distilling even a dilute infusion of the bark, when the liquid which passes over will be found to strike a deep purple colour with a persalt of iron, which is very persistent. The bark of old larch trees contains very little larixinic acid; but the bark of the small branches, and that of the stems of the larch, when not more than from twenty to thirty years of age, contains very considerable quantities of this substance, the concentrated syrup from the portions of bark yielding more larixinic acid than an equal weight of catechu does of oxyphenic acid. Larixinic acid, after it has been purified by sublimation, forms beautifully white crystals, often more than an inch in length, of a brilliant, silvery lustre, very much resembling benzoic acid in appearance. They sublime at 93° C., and melt at 153° C.; but its aqueous solutions volatilise at ordinary temperatures.

The smell of the aqueous solution of larixinic acid is sweetish, like that of a syrup, but the smell of the sublimed acid is very peculiar and slightly empyreumatic. As larixinic acid emits a sensible odour at ordinary temperatures, in this respect it considerably resembles naphthaline and ordinary camphor. The taste of larixinic acid is slightly bitter and astringent. It reddens litmus-paper very slightly; but a single drop of potash or ammonia, when added to a solution of a large quantity of larixinic acid, renders it alkaline. Larixinic acid is very soluble in boiling water, but is by no means very soluble in cold water, 87·88 parts of water, at 15° C., dissolving 1 part of the acid only; but the solubility of larixinic acid in cold aqueous solutions is greatly increased by the addition of either acids or alkalies. Larixinic acid is deposited from its aqueous solutions in crystals, which are very brittle, and often an inch or two in length. It likewise dissolves in cold alcohol, but to a much greater extent in hot alcohol. The crystals deposited from its alcoholic solutions are thicker and more distinctly formed than those from water. It also dissolves but sparingly in ether, and is deposited in crystals of very considerable lustre.* The following are the results of the analysis of the larixinic acid:—

I. 0·221 sublimed acid, dried *in vacuo*, gave 0·4633 carbonic acid, and 0·1003 water.

II. 0·1993 sublimed acid, dried *in vacuo*, gave 0·417 carbonic acid, and 0·0913 water.

III. 0·2272 larixinic acid, crystallised out of water, gave 0·4756 carbonic acid, and 0·1030 water.

Calculated Numbers.	Found.		
	I.	II.	III.
$C_{20} = 57·14$	57·13	57·06	57·09
$H_{10} = 4·77$	5·04	5·09	5·04
$O_{10} = 38·09$	37·83	37·85	37·87

From these results it is evident that the carbon, hydrogen, and oxygen in larixinic acid are in the proportion of $C_2H_1O_1$, or some multiple of these numbers, $C_{20}H_{10}O_{10}$ being the numbers we have adopted as the more probable.

When a quantity of larixinic acid was dissolved in a great excess of liquid ammonia, a yellow-coloured solution was produced; when this was evaporated to dryness over sulphuric acid *in vacuo*, the larixinic acid was deposited in crystals which were nearly unaltered. It gave its characteristic reactions with salts of iron, and when boiled with milk of lime gave off no trace of ammonia. The combination which larixinic acid forms with ammonia is, therefore, so feeble that it is decomposed by the volatility of the ammonia. In this respect, therefore, and in its forming no hydrate, larixinic acid closely resembles both pyrogallic and oxyphenic acids.

When larixinic acid was treated with an excess of aqua potassæ it very readily dissolved, forming a yellowish solution. When dried over sulphuric acid *in vacuo*, the potash combination formed long flattish crystals having considerable lustre, but of a reddish-brown colour. These crystals, when pressed between folds of blotting-paper to free them from excess of potash and recrystallised *in vacuo*, yielded crystals which were more deeply coloured than the first. This potash combination is so very feeble that it is decomposed by carbonic acid. It contained a considerable quantity of potash; but I have not been able to obtain it of a constant composition.

A solution of larixinic acid gives no precipitate, either with lime-water or with saccharate of lime. The behaviour of larixinic acid with baryta is extremely singular and characteristic. When a solution of caustic baryta is added to a concentrated aqueous solution of larixinic acid, the latter being in excess, a bulky, semi-transparent, gelatinous precipitate immediately falls, and if the solutions are concentrated fills the whole vessel. This precipitate, which considerably resembles hydrated alumina, is but slightly soluble in cold water; but it dissolves very readily in boiling water, from which it is again deposited on the cooling of the liquid. This baryta compound is readily decomposed by carbonic acid. When thrown on a filter and washed, the air being carefully excluded, it was dried *in vacuo* over sulphuric acid, and was then found to contain, as the mean of two experiments, 34·92 per cent. of baryta.

A solution of larixinic acid yields no precipitate with either basic or neutral acetate of lead, neither is it precipitated by nitrate or ammonio-nitrate of silver; but when its solution in the latter salt is boiled, the silver is reduced in a pulverulent state. Larixinic acid forms no precipitate with perchloride of platinum, even on the application of heat. It does not contain any nitrogen. It does not reduce oxide of copper when tried by Trommer's test. It dissolves in concentrated sulphuric acid, but no conjugate combination is produced, as was ascertained by neutralising with carbonate of baryta, larixinic acid being obtained unchanged. When larixinic

* The crystals of larixinic acid catch fire readily and burn with a bright flame, leaving no residue.

acid is boiled with a mixture of hydrochloric acid and chlorate of potassa, it is decomposed, but without the formation of chloranile. When it is boiled with a solution of hypochlorite of lime, no coloration is produced. It is readily attacked by nitric acid, especially when assisted by heat; nitrous fumes are given off, and oxalic acid is the only fixed product. It is also readily attacked by bromine, especially when assisted by heat. Abundant vapours of hydrobromic acid are given off, the larixinic acid being entirely destroyed and converted into an uncrystallisable resin. The salts of copper produce an emerald green colour in solutions of larixinic acid, but no precipitate. Chloride of manganese produces neither coloration nor precipitation. Protosulphate of iron strikes a brownish-red colour with solutions of larixinic acid, which acquire a brighter red colour on standing, resembling meconate of iron. Perchloride and persulphate of iron produce a beautiful purple dahlia-colour, which is very persistent, and stands dilution well. Its reactions with salts of iron are very characteristic of larixinic acid, which forms an excellent reagent for the detection of salts of iron, even in very minute quantity. In this way the presence of iron, in tolerably pure sulphate of copper, can readily be detected by the purple coloration produced. Larixinic acid does not affect neutral protonitrate of mercury in the cold; and on the application of heat no mercury is reduced.

Larixinic acid appears to be peculiar to the larch-tree: at least I have not been able to find a trace of it in the bark of the spruce fir (*Abies excelsa*), or in that of the Scotch fir (*Pinus sylvestris*). Larixinic acid evidently belongs to that small group of substances of which pyrogallic acid and pyrocatechine, the oxyphenic acid of Gerhardt, are the only other members yet known. Larixinic acid is much less easily oxidisable than oxyphenic acid, which again is less easily oxidated than pyrogallic acid. Larixinic acid volatilises at a much lower temperature than either of these two substances, from which it also differs in being a ready-formed proximate principle, and not an educt.

Addendum.—In consequence of the extremely feeble, if not somewhat doubtful, acid properties of the so-called larixinic acid, perhaps the name *Larixine* would be more appropriate; but in that case the name of pyrogallic acid should be altered to *pyrogalline*, and that of oxyphenic acid to *pyrocatechine*, the name originally given to it by Zwenger.—J. S.—*Transactions of the Royal Society*, 1862.

On the Action of Water on Commercial Chloride of Lime, and Remarks on its Chemical Constitution, by M. Fresenius.

It is generally admitted that chloride of lime is composed of a mixture of hypochlorite of lime, chloride of calcium, and hydrate of lime; or a combination of hypochlorite of lime with chloride of calcium, mixed with hydrate of lime. M. Millon, on the contrary, considers it to have the composition CaO,Cl. The author thought that the action of water on chloride of lime would throw some light on its constitution.

The chloride of lime employed for analysis was taken from a large sample of 250 kilogrammes. It yielded 26·52 per cent. of chlorine, and 13·25 per cent. of hypochlorous acid. To estimate the whole of the chlorine, a weighed quantity was treated with water and ammonia, nitrate acid added, and the solution then neutralised by carbonate of soda. The chlorides were then estimated in the liquid by nitrate of silver. By the volumetric process with bichromate of potash, 29·57 per cent. of chlorine was found.

The lime was precipitated by oxalate of ammonia. Two analyses yielded 46·35 per cent. and 46·40 per cent. Mean = 46·37 per cent. From these numbers the following composition is calculated:—

CaO,ClO	26·72
CaCl	25·51
CaO	23·05
Water	24·72
	100·00

Which may be thus stated:—

CaO,ClO	26·72
CaCl (in combination with the above as CaO,Clo + CaCl)	20·72
CaCl in excess	4·79
CaO,HO	30·46
Water combined	17·31
	100·00

The author has verified this composition in the following manner:—

A weighed portion of chloride of lime was treated with a known volume of hydrochloric acid. The reaction was conducted in a flask furnished with a long glass tube to avoid loss of the acid. The difference in strength of the hydrochloric acid before and after the experiment showed the quantity of acid saturated by the lime. This was found to be equivalent to 57·206 of anhydrous acid for 100 of the chloride. This closely approximates the amount required by theory. The reaction is as follows:—

$$CaO,ClO + CaCl + 2HCl = 2CaCl + 2HO + 2Cl.$$

26·72 of hypochlorite and 20·72 of chloride of calcium being present in 100 parts of chloride of lime, there would be then 47·44 per cent. of chloride of lime, requiring 27·24 of hydrochloric acid, the 30·46 of hydrate of lime requiring also 30·01 of acid, making 57·25 together. Experiment gave 57·206.

The lime of the 4·79 of chloride of calcium, not having been saturated by the acid, would remain in excess.

50 grammes of chloride of lime were treated with ten successive gradually increasing portions of water. 80 grammes of water were employed for the first lixiviation; the mass being thrown on a filter, 20 grammes of filtrate were obtained. A second lixiviation yielded 30 grammes of solution, a third 100, a fourth 120, &c. The results are shown in the table below.

These solutions were analysed immediately after filtration to avoid as much as possible the action of the air. The chlorine and hypochlorous acid were estimated as before; the same estimations were also made in the deposit remaining after the tenth washing. The following numbers were obtained:—

Solution.	CaO,Clo.	CaCl.	Atoms of CaCl for 1 atom of CaO,ClO.
1.	4·5371	15·9437	4·5279
2.	5·2254	7·6451	1·8851
3.	3·6968	2·6064	0·9084
4.	1·6004	0·9897	0·7968
5.	0·4672	0·2971	0·8193
6.	0·1600	0·1198	0·9647
7.	0·0602	0·0487	1·0422
8.	0·0128	—	—
9.	0·0060	0·0067	1·4319
10.	0·0039	0·0043	1·4521
Residue	0·1389	0·0321	0·2981

The following conclusions are drawn from these experiments:—

1st. The first portion of water (80 grammes) dissolved all the chloride of calcium, as the last portions contained very little.

2nd. The hypochlorite of lime, on the contrary, entered gradually into solution.

3rd. At the end of the third lixiviation all the free chloride of calcium was dissolved; for from this time the proportion between the hypochlorite of lime and the chloride of calcium became nearly regular.

4th. As the chloride of calcium dissolves at once completely, while the hypochlorite dissolves principally after the third lixiviation, it results that either these two bodies are in combination, or that the water decomposes chloride of lime into hypochlorite and chloride of calcium.

5th. The author considers that the hydrate of lime is combined with the chloride of calcium, forming a basic chloride. This would explain the reason why 4 atoms of hydrate of lime take 2 atoms only of chlorine. This opinion is supported by the fact that the crystalline compound $3CaO,CaCl+16HO$ is decomposed by water into hydrate of lime and chloride of calcium.

6th. The author assigns to chloride of lime the following formula:—

$$CaO,ClO+CaCl,2CaO+4HO.$$

7th. The hydrate of lime separated when the chloride of lime is treated with water, retains with great force a certain amount of hypochlorite which repeated washings will not remove. In estimating exactly the hypochlorous acid in chloride of lime, it is necessary, therefore, to value the deposit with the solution. For commercial purposes, however, it is better to assay the clear solution filtered from the deposit, as that alone is employed, the deposit being usually rejected.—*Répertoire de Chimie.*

On the Presence of Lactic Acid in Lepra Scales, by JOHN HORSLEY, *F.C.S.*

A SHORT time since a medical gentleman sent me a small packet of lepra or psoriasis scales, with a request that I would examine them for lactic acid, being under the impression, from something he had heard, that such was present, as, if so, it would suggest the proper remedial treatment.

From the apparent difficulties in the way of extracting the lactic acid as a salt of lime or otherwise, it occurred to me to try the conversion of it into glucose. Accordingly, I ground the scales to fine powder, and then into a paste with a few drops of water, boiling them in a larger quantity of water, slightly acidulated with sulphuric acid, for several hours. After filtration I boiled the liquor with the cupreous solution mentioned by me in No. 104 of the CHEMICAL NEWS, when the usual brick-red precipitate was obtained, indicative of the existence of sugar; but from the smallness of the quantity of scales operated on I was unable to determine the percentage.

New Researches on the Formation of Hydrocarbons, by M. BERTHELOT.

IN the researches which I have published during the last five years, I have established the synthetical formation from their elements of the simple hydrocarbons and of the alcohols.

I have described sure methods of effecting thes transformations. However, the simplicity of the result appearing to leave something to be desired, I have undertaken fresh researches, in order better to render evident the regular chain of transformation. Let me first recall to mind a few of the facts already established, so as to mark the progressive operations.

1. Carbon and oxygen unite to form oxide of carbon; hydrogen and oxygen unite to form water:—

$$C_2+O_2=C_2O_2;\ H_2+O_2=H_2O_2.$$

2. Oxide of carbon and water unite to form formic acid:—

$$C_2O_2+H_2O_2=C_2H_2O_4.$$

3. Formic acid (in the state of formiate of baryta) changes into marsh gas, water, and carbonic acid, according to a simple equation analogous to that by which acetic acid changes into acetone:—

$$4C_2H_2O_4=C_2H_4+2H_2O_2+3C_2O_4.$$

It is here that my new researches commence.

4. Pure marsh gas submitted to the action of heat, or, better, to the spark of a powerful induction-coil, undergoes a remarkable metamorphosis. Whilst a certain amount splits up into its elements, another very considerable portion condenses into a more complicated hydrocarbon acetylene:—

$$\underset{\text{Marsh gas.}}{2C_2H_4}=\underset{\text{Acetylene.}}{C_4H_2}+H_6.$$

Nothing is easier than to obtain in this manner large quantities of acetylene in the state of purity by reproducing it from the cupreous acetylide formed from the crude product of the reaction.

To render these results more decisive in what relates to the formation of acetylene from its elements, I have reproduced it with marsh gas obtained from formic acid, that is to say, from water and oxide of carbon. This marsh gas, previously washed with bromine and potash, furnishes, indeed, acetylene,—a result easy to foresee, but which I think it necessary to verify as a counter-proof to my first experiments.

5. The acetylene thus obtained becomes a starting-point for new formations. Indeed, I have previously shown that nothing is easier than to change it at the ordinary temperature into olefiant gas:—

$$\underset{\text{Acetylene.}}{C_4H_2}+H_2=\underset{\text{Olefiant gas.}}{C_4H_4}.$$

This is one of the neatest examples of the fixation of hydrogen in an organic substance. It is effected by attacking zinc by ammoniacal water in the presence of acetylide of copper. Here are some new details on the analysis of the products of this reaction. These products consist of hydrogen and olefiant gas, mixed with a little acetylene which has escaped metamorphosis. The method of analysis which I am about to point out is essentially qualitative. It admits of isolating in a manner each of the elements of a gaseous mixture; and the process is the more useful to be known, inasmuch as a similar analysis appears to have recently given rise to rather serious errors. The gaseous mixture is treated with ammoniacal protochloride of copper, which dissolves *simultaneously* the hydrocarbons $C_{2n}H_{2n-2}$, such as acetylene, and the hydrocarbons $C_{2n}H_{2n}$, such as olefiant gas; but the acetylene forms an insoluble combination, which is not destroyed by the ebullition of the liquid,—a double property which admits of its separation; whilst the olefiant gas simply enters into solution, and may be disengaged in the state of purity on boiling the liquid. It is thus obtained isolated, and may be washed with dilute

sulphuric acid to free it from ammoniacal vapours, and then submitted to eudiometrical analysis.

6. Olefiant gas, C_4H_4, formed from acetylene, C_4H_2, may in its turn be surhydrogenised and transformed into acetene, C_4H_6:—

$$\underset{\text{Olefiant gas.}}{C_4H_4} + H_2 = \underset{\text{Acetene.}}{C_4H_6}.$$

This is effected by a general method, which I published five years ago, and which has since received more than one application. It consists in fixing bromine on the first hydrocarbon, so as to form a bromide $C_4H_4Br_2$; then in replacing the bromine by hydrogen. This inverse substitution takes place very readily by the employment of iodide of potassium and water, without other agents.

I think it will be as well to mention here that this fact, and the reduction of glycerine by iodide of phosphorus, constitute the first examples of the use of iodised compounds as reducing agents. We know how fruitful this method has become of late years. Among the other results that I have succeeded in realising I will only mention one to conclude this account. It is,—

The complete deoxidation of glycerine $C_6H_8O_6$
And its transformation into the carbide C_6H_8

But let us return to the progressive construction of hydrocarbons.

7. Marsh gas, acting upon oxide of carbon, forms propylene, conformably to the following reaction, which I have already noticed:—

$$\underset{\text{Marsh gas.}}{2C_2H_4} + C_2O_2 = \underset{\text{Propylene.}}{C_6H_6} + H_2O_2.$$

8. The same marsh gas, sealed in a Bohemian glass tube, then heated to a temperature at which the glass begins to soften, gives rise to a small quantity of naphthaline. The greater portion resists. The formation of naphthaline from marsh gas may be represented by the following equation:—

$$10C_2H_4 = C_{20}H_8 + H_{32}.$$

It recalls the formation of chloride of Julin, $C_{20}Cl_{10}$, from perchloride of carbon, C_2Cl_4.

To resume, we can form

From their elements, oxide of carbon and water;	
From these latter, formic acid;	
From formic acid, marsh gas	C_2H_4;
From marsh gas, acetylene.	C_4H_2;
And, consecutively, olefiant gas	C_4H_4;
And acetene	C_4H_6;
From marsh gas and oxide of carbon, propylene	C_6H_6;
And, finally, from marsh gas, naphthaline .	$C_{20}H_8$.

All these formations result from a regular series of simple reactions, exerted at first on the elements, then on the hydrocarbons. They establish the gradual and direct generation of hydrocarbons of more and more complexity from more simple carbides.

Parallel to this method, founded on the progressive condensation of the hydrocarburetted molecule, I may mention the method of simultaneous condensations, the applications of which I have otherwise developed. In the dry distillation of formiates, acetates, and analogous bodies, one and the same hydrocarbon molecule, C_2H_2, separates simultaneously in several different states of condensation; such as

Olefiant gas . .	$(C_2H_2)^2$
Propylene . .	$(C_2H_2)^3$
Butylene . . .	$(C_2H_2)^4$
Amylene . . .	$(C_2H_2)^5$

The constitution of the principal of these hydrocarbons has been verified by the formation of the corresponding alcohols.*

Such are at present the only methods established by experiment which allow of starting from their elements to arrive at carbides, at first simple, then more and more complex. Other analogous processes will undoubtedly be discovered, for such is the course of experimental science; but I think that the progress which may be made in this direction will be based upon the same general principles. Indeed, the two great paths of synthesis in organic chemistry are progressive condensation or simultaneous condensation, either at the expense of the elements of a single compound, or at the expense of the joint elements of two compounds. On these two principles depend all the general methods already found out experimentally, and of which more are being discovered every day. Now that synthesis has overcome the first and greatest obstacles,—I mean those which hindered the formation of hydrocarbons and alcohols from their elements,—the path widens as we advance; the compounds formed from these first terms become more numerous and undergo more varied and delicate metamorphoses. As is the case in other progressive sciences, the resources increase at each new step, whilst chemists become familiar with a series of problems of which they were hitherto almost entirely ignorant.—*Comptes-Rendus*, liv. 515.

TECHNICAL CHEMISTRY.

On Cæruleum, a New Colour, by M. Bleckrode.

Under the name of cæruleum, a blue colour has for some time been met with in commerce, which does acquire a violet tinge in artificial light. It covers perfectly, is not gritty, and is especially appropriate for representing the blue of the sky. It is unchangeable in the sun and in mephitic atmospheres, and at the same time stands tolerably high temperatures as well as alkalies and acids. It is therefore a colour which can be recommended for its sterling qualities. M. Bleckrode has analysed it, and found it to consist of—

SnO_2	49·66
CaO.	18·66
Plaster	34·68
Silica	traces

The State of the Thames.

We quote the following account of the state of the River Thames during the past quarter of the present year and the whole of 1861 from Dr. Letheby's "Report on the Sanitary Condition of the City of London for the Quarter ending June 30, 1862":—

"In consequence of the large supply of rain, the river, during the last three months, has been remarkably free from impurities. The average amount of saline and organic matter in solution in the water at high tide at London Bridge has been but 26·5 grains per gallon, of which 2·8 were organic; and the suspended matter amounted to only 3·2 grains per gallon, only about 0·7 of which were organic. Contrasted with the water from the City pumps, this is comparatively pure. The highest

* It is also known to how many proofs the carbides obtained in the dry distillation of the acids $C_{2n}H_{2n}O_4$, and analogous bodies have been submitted by the experiments of MM. Reynolds, Hofmann, Cahours, Wurtz, &c. (The preparation of numerous chlorine and bromine derivatives, formation of glycols, &c.)

temperature of the river during the whole year was 61·9 degrees.

"The water for examination has been taken at high tide, at mid-stream, at London Bridge, and at six feet from the shore on the City side of the bridge. The chief differences in these situations are, a rather larger proportion of dissolved matter at mid-stream, and of suspended matter near the shore. The fluctuations in the composition of the water during the past year were from about 33 grains in the gallon during the first six months of the year, to about 200 in the months of August, September, October, and November. In the months of September and October the river was offensive. The dissolved matter amounted to from 188 to 203 grains per gallon, of which from 8 to 19 grains were organic. The temperature of the river during those months ranged from 60 to 66 degrees, and the rain-fall from less than an inch to an inch and a-half. Altogether, the proportion of impurity in the river was about twice as great as in the preceding year, when the rain-fall, especially in the spring and summer months, was larger, and the temperature lower."

On the Souchon Process for Filtering Water.

This method of filtering consists in passing water through woollen clippings which have previously undergone a treatment for the purpose of destroying and carrying away the vegetable matters which have served to dye them, and to coat them with a layer of tannate of iron, which renders it imputrescible. This treatment is performed in the following manner:—

The wool is washed and immersed for five or six hours in a bath made with—

Water of *javelle* . . .	1000 grammes
Carbonate of soda. . .	250 ,,
Water	25 to 30 litres

Raise the temperature to 50° or 60°, and then wash. The wool is then immersed for five hours in a boiling bath composed of—

Alum	250 grammes
Cream of tartar . . .	30 ,,
Water	12 litres

On coming out of this bath the wool is exposed to the air for some hours. It is then boiled for two hours with the following infusion of gall-nuts:—

Gall-nuts	200 grammes
Boiling water . . .	10 litres

After this galling it is plunged into a boiling bath of acetate of iron. The gall and ferruginous bath are then repeated a second time, the wool being allowed to remain in the bath for some hours; dry it without washing, and then plunge it for an hour in the following bath of carbonate of soda:—

Carbonate of soda . .	250 grammes
Water	20 litres

Wash the wool until the water passes away clear and tasteless. This kind of filter is applied to several public fountains in Paris.—*Rapport du Conseil d'Hygiène et de Salubrité.*

Neutral Sulphate of Quinine.—According to Jobst and Hesse (*Annal der Chem. und Pharm.*, bd. cxix. p. 361), this salt contains 15 equivalents of water, and not 14 as generally admitted. They have also found that one part of the salt dissolves in 793 parts of water at 43° F., and 788 parts of water at 49° F. One part of the salt is also soluble in from 100 to 115 parts of alcohol sp. gr. 0·852.

PHARMACY, TOXICOLOGY, &c.

An Analytical Mistake.

We have before had occasion to caution our readers against undertaking toxicological examinations unless specially qualified for the task. The following case may perhaps prove instructive in pointing out sources of error, and in showing the toxicologist to what delusions he is liable. We extract only the chemical part of Mr. Nunneley's written report of the analysis of portions of the body of Mrs. Atkinson (premising that Mr. Nunneley had assured himself of the purity of his reagents), and Dr. Taylor's evidence after examining portions of the viscera which remained:—

"The following parts were separately analysed, and by the process known as Reinsch's, all yielded distinct metallic stains upon the copper foil boiled with the structures and hydrochloric acid:—First, the rectum, when the coating on the copper was decided; second, five ounces of the liver yielded dark grey stains on several pieces of copper; third, the colon, or large intestine, gave the same stains; fourth, the lower end of the small intestine with the cœcum gave a similar colour to the copper; fifth, the small gut gave similar results; sixth, one-half of the stomach itself yielded the same metallic coating, but the thick matter, scraped from its surface, did not give any coating to the copper boiled with it; seventh, the kidney gave as distinct stains as the liver did; eighth, from the little spleen, the same evidence was obtained; ninth, the small quantity of red fluid which had drained from the viscera also yielded the same grey dark coating to the copper; tenth, the omentum yielded a like, but a much less distinct, stain; eleventh, part of the coated copper from the small intestine was placed in a short subliming-tube, and yielded on a slip of microscopic glass a few very minute octohedral crystals; twelfth, the copper coated from the omentum was similarly treated, and also yielded a few similar crystals; thirteenth, part of the copper used in the analysis of the stomach and liver gave decided symptoms of arsenious acid; fourteenth, from the copper used in the analysis of the rectum an equally evident layer of octohedral crystals was obtained. From a minute sublimate obtained from the copper used in the large intestine analysis, a slight yellow stain was seen to be formed on the addition of water and the ammonia-nitrate of silver. A sublimate obtained from the copper used with the spleen was boiled in distilled water, and one portion of this yielded a green precipitate on the addition of the ammonia-sulphate of copper. Six ounces of the liver was treated with sulphuric acid, dried, and then with nitric acid for being used in Marsh's apparatus, and the result was a mere stain, which yielded so slight a yellow colour with the ammonia-nitrate of silver that the result must be regarded as negative. Another portion of the liver was first dried and treated with sulphuric acid until carbonised and dry, and subsequently to nitric acid for use with Marsh's apparatus, and the result was similar to that in the last experiment, namely, negative, except a stain too slight to be relied on. This result I am convinced is only what might be expected, and will, I believe, be found to occur in similar circumstances when the quantity of absorbed arsenic is small, and is combined with the animal tissues in the condition those submitted to me were, for the difficulty of drawing off the water and securing the entire disintegration, so as to get the arsenic free without the loss of it, is so great that I regard this process, though much used and very satisfactory where arsenic exists in a large quantity or in a condition of ready solubility, as of much less delicacy than Reinsch's, and consequently of much less value in a case like the present. Considering

that by Reinsch's process metallic deposits of a characteristic iron grey colour were obtained from so many different viscera, that proves at least four of these distinct minute octohedral crystals were sublimed, and that no other substance than arsenic will yield such results; considering that a minute portion of common white arsenic, treated as nearly as possible in a like manner, yielded corresponding results, I can arrive at no other conclusion than that arsenic was present in most, if not all, of the organs of the body, and that it had been introduced during the lifetime of the deceased, and that probably at some short period anterior to death. That the quantity actually present in any one organ at the time the analysis was made was small is proved by the negative results of Marsh's tests and the slight results of the liquid tests; but these do not destroy the positive evidence obtained by the other processes. As the whole of the viscera had not been used in the analysis, it is very probable the remaining portions, with a further and more complete examination of the coated copper already obtained, may confirm more decidedly the opinion I now give.

"Mr. Chipperfield asked if the witness wished to make any addition to his report?

"Mr. Nunneley replied that in consequence of a recommendation to that effect the body of the late Mrs. Atkinson had been re-exhumed on Monday, the 23rd of June last. He was present on that occasion at Kirkby Lonsdale, and had removed the whole of the remaining viscera, as well as portions of the muscles from different parts of the body, and also part of the brain. He was quite sure that these portions had not been before removed or disturbed. These were placed in jars and sealed by witness, and forwarded to Professor Taylor, in conjunction with whom he subsequently made an examination. From the kidneys, which he had sent up, by the application of tests, minute microscopic globules were obtained which possessed more the character of mercury than arsenic, and on further investigation of the stains on the copper foil, proof of the presence of arsenic was not obtained, and the conclusion to which he had now arrived was that there was no proof that the death of the deceased was caused by arsenic, but that it was caused in all probability by some other irritant poison.

"Mr. Chipperfield: Are you prepared to say that arsenic was not used, or simply that you found no evidence of its presence?—Witness: I did not find such proof of arsenic that I could swear to its presence. The presence of octohedral crystals is only one portion of the proof of the presence of arsenic, and it requires to be confirmed by other tests before it can be sworn to.

"Mr. Chipperfield: Supposing death to have been caused by an irritant poison, might solution of arsenic form one of the agents used, and leave no trace?—Witness: It is possible it might be one of the agents.

"Mr. Chipperfield: Can you say it was not used?—Witness: The analysis affords no proof that it was used.

"Dr. Alfred Swaine Taylor was next called, and proved that on June 24 last he received portions of the remains of the deceased Mrs. Atkinson, at Guy's Hospital. These I subjected to the following analysis: first, two ounces of the red liquid, which was derived from the jar containing the whole of the viscera, were examined for arsenic, antimony, and mercury, but none of these poisons were present; second, three and a-half ounces of the lungs were tested by a similar process, but no arsenic or other matter was detected. In consequence of these negative results in my preliminary testing of the remains, I invited Mr. Nunneley to attend at the laboratory at Guy's Hospital, in order that we might analyse portions of the body together, and he was present on Saturday, June 28, when the remaining kidney was selected for our conjoint experiment. The materials to be employed having been tested and their purity determined, the kidney, which weighed 1½ ounces, was submitted to Reinsch's process. A very small portion of pure copper foil was used, in order that the minutest trace of arsenic up to the 500th part of a grain might not escape detection. After boiling the liquid a sufficient time, the copper was removed, and presented a slight tarnish, but not like that produced by arsenic. Another piece of copper was then introduced, and this was tarnished in a similar manner, but in a less degree. The tarnished copper was then tested, but no crystals of arsenious acid could be obtained. There were seen under the microscope some globules of moisture, and some minute globules presenting the characters of metallic mercury. On the same occasion Mr. Nunneley produced for examination a number of slips of copper foil which he had employed in testing by Reinsch's process in April, 1862. These were cut into small pieces, and tested specially for arsenic with the usual precautions, and the result was that neither Mr. Nunneley nor myself could extract from those pieces of copper any crystals of arsenious acid. The stained copper from the lower rectum and kidney was also examined with negative results. The portions of copper selected for these experiments were those which presented the dark grey coating in the stronger degree. Globules of moisture were alone visible under the microscope, with the exception of the sublimate derived from the stained copper of the kidney analysed by Mr. Nunneley in April last. In this case minute globules resembling those of metallic mercury were perceptible, and they had the form and character of the globules observed in the sublimate derived from the remaining kidney analysed by us on June 28. As some of them were measured by the micrometer, and were found to be not more than the 4000th part of an inch in diameter, it is obvious that any crystals of arsenic of a similar size would have been visible under the microscope. I have since submitted to further examination six ounces of the lungs of the deceased, with a view to determine whether by operating on a larger quantity the results would be different. There was a slight tarnish on the small piece of copper used, but this was unlike the effect produced by arsenic. On applying further tests to the tarnished copper no arsenic was detected. A sample of the earth of the grave in which the coffin had been deposited was analysed, and it was found to contain a small quantity of arsenic. The conclusions which I draw from this analysis and investigation are, first, that those parts of the deceased's body which were sent to me for examination—namely, the lungs, one kidney, and a portion of the blood—contained no arsenic; secondly, that the only metallic substance found by analysis consisted of minute globules presenting the character of mercury, and those were separated from the kidney; thirdly, that in reference to the research for arsenic, Mr. Nunneley has examined, and I have not had an opportunity of examining the stomach and intestines and their contents, as well as the whole of the liver and spleen—parts in which poison is more commonly detected after death—while I have examined, and Mr. Nunneley has not examined, the lungs, and I have found no arsenic therein; fourthly, that the only parts of the body that have been examined by both of us are the red or bloody liquid derived from the viscera and next the kidney. In his analysis of these parts in April, 1862, Mr. Nunneley obtained a dark grey coating on copper, from which, however, it appears he obtained nothing to show that in either case the coating was caused by arsenic. In my analysis of June 26, the bloody fluid referred to gave no coating or tarnish to the copper, while the kidney analysed by Mr. Nunneley and myself on June 28 caused a slight tarnish or deposit on the metal, from which no arsenic could be procured, but globules resembling those of mercury were obtained. Fifthly, that the samples of stained or coated copper foil produced by Mr. Nunneley, as representing parts of the results obtained by him in his analysis of the liver, rectum, and kidney of the deceased in April, 1862, when further

tested by both of us on June 28, yielded no arsenic. Sixthly, that although a trace of a substance resembling arsenic was found in the earth of the grave surrounding the coffin in which the deceased was buried, this could not account for the presence of arsenic (if present) in the viscera examined by Mr. Nunneley."

We shall probably refer to this case on a future occasion.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

2059. George John Yates and John William Ward Tindall, Liverpool, "A process of deodorising paraffin, coal, pitch, rock, and other like oils and hydrocarbons."

2061. Richard Archibald Brooman, Fleet Street, London, "Improvements in revivifying animal black, in apparatus employed therein, and in recovering a product employed in the revivification."—A communication from Absolon Hippolyte Leplay and Jules François Joseph Cuisinier, Paris.

2073. Alexander Morrison Fell, Auchanhard, Linlithgow, N.B., "Improvements in obtaining or manufacturing sulphate of ammonia and manure."—Petitions recorded July 21, 1862.

2170. Elijah Freeman Prentiss, Birkenhead, Cheshire, and Robert Adam Robertson, Liverpool, "Improvements in obtaining products from rock oil, coal tar, and other like mineral substances in a more or less pure or deodorised state, and in the apparatus to be used therefore, and which is also applicable to distillation in general."

2206. William George Valentin, Oxford Street, London, and Frederick Levick, Blaina, Monmouthshire, "Improvements in the generation of combustible gases for lighting and heating purposes, and in the mode of applying such gases to the manufacture of iron, glass, and other processes in the arts where great heat is required."

Notices to Proceed.

1005. Thomas Cobley and James Wright, Bridge Street, Blackfriars, London, "Improvements in the method of, and the apparatus for treating auriferous and argentiferous minerals and ores for the purpose of extracting and separating the gold and silver from the other metals, minerals, and substances combined therewith; also in the method of treating the various residues resulting therefrom, and in the utilisation, application, and use of the said residues when so treated."—Petitions recorded April 8, 1862.

1058. Edgar Drewett, Blackheath, Kent, "Improvements in bottles and other vessels, whereby to separate and retain sediment from their contents."

1177. William Moir, Manchester, "An improved instrument for ascertaining the specific gravity of liquids."

1235. Gustav Bischof, jun., Swansea, "Improvements in treating solutions containing copper and silver, or either of them, to obtain metallic copper and silver."—Petitions recorded April 26, 1862.

1874. George Peterson, Brompton Square, London, "Improvements in apparatus for ascertaining the quantity and strength of spirits or other products obtained by the process of distillation."—A communication from Theodor Steinberg, Oseenovoy Koost, near Saratof, Russia.—Petition recorded June 26, 1862.

CORRESPONDENCE.

The Jury Award for Thallium.

To the Editor of the Chemical News.

Sir,—Let me say a few words with reference to the Jury Awards to the exhibitors of thallium.

The fact that you are the discoverer of thallium is, of course, incontrovertible. A new element is not to be discovered every day, and when such a discovery has been made and publicly announced, it is the duty of any one who has to adjudicate concerning it, to take care that no mistake occurs. The Jurors of Class II., being for the most part foreigners by birth, should have avoided being guilty of so grave an injustice to an Englishman. How is it that all the medals and honourable mentions awarded for lollipops and bear's-grease are faithfully recorded, while a discovery of the largest interest is completely ignored? Who is to blame? Was the omission the fault of the Jurors or the printer? Did forgetfulness, or carelessness, or ignorance, or worse still, did prejudice occasion the error? Have you seen the "copy" furnished by the jurors to the printer?

One word more. The Jurors have neglected not only to offer you an apology, but to repair the consequences of their blameworthy neglect. The medal in itself is worth nothing; the due and full statement of its having been awarded is everything. The least that could have been done would have been to have inserted in every copy of the Book of Awards sold since the receipt of your letter to the Commissioners, a slip of paper with the nature of the omitted award described thereon. The defective record is being reprinted in a hundred papers.—I enclose my card, and remain yours, &c.

Spectroscope.

August 26.

To the Editor of the Chemical News.

Sir,—All British chemists, and, indeed, chemists of all nations, including, I should think, M. Lamy himself, will strongly sympathise with you in your dispute with the Commissioners of the International Exhibition. A gross injustice has been done, not only to you, but to the country. One's criticism is certainly to a great extent disarmed by the admission on the part of the Commissioners that the omission of your name was an inadvertence. But how that could be it is hard to see. The lists one would suppose were revised by the Jurors, or, at all events, by some responsible person who had the reports of the Jurors to refer to; and how it could happen that the names of persons who were awarded medals were omitted, and the names of persons who had nothing in the Exhibition inserted, is most extraordinary. Great carelessness must have been exhibited by somebody, who, if blunderers received a medal, was certainly deserving of one.

You may rest assured that notwithstanding the mistake avowed, your claim to the discovery of the new metal will never be disputed. I would not, nor would you, I am sure, wish to detract in the least from M. Lamy's claim to an award. He was fortunate in being able to command an unlimited supply of a source of the metal, had large means at his command for working it, and showed great industry in availing himself of these means, and he certainly produced a fine specimen of the metal, a specimen which placed the existence and individuality, as one may say, of the element beyond dispute, and thereby, I contend, settled incontestably your right to the honour of a medal.

One is happy to learn that the great chemists of Europe, who constituted the Jury of Class II., are not responsible for the omission, the blame of which, I suppose, will be laid on that unfortunate Register Clerk, and the apparently blind Deputy Commission, as in the case of the Messrs. Muspratt.—I am, &c.

An English Chemist.

August 25.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Artificial Formation of Wolfram.—By calcining a mixture of one part of ferrous chloride, one part of man-

ganous chloride, six parts of chloride of sodium, and five of tungstate of soda, Geuther and Forsberg (*Annal. der Chem. und Pharm.*, bd. cxx. s. 270), obtained some small crystals, which when fused with their own weight of the chlorides of iron and manganese were changed into larger black crystals, having the composition $MnO,WO_3 + 3\,(FeO,WO_3)$. This body corresponds to the wolfram of Limoges and Cumberland, analysed by Schaffgotsch and Berzelius. The authors obtained several other compounds of manganese, iron, and tungsten.

Composition of the Crystals Obtained in the Manufacture of Sulphuric Acid.—Under the foregoing title Dr. R. Weber describes (*Bericht. der Akad. der Wissensch zu Berlin*, 1862, s. 121), the analysis of some crystals procured by passing dry sulphurous acid through fuming nitric acid. The former acid was passed until the contents of a wide-necked flask in which the nitric acid was placed, and which was kept well cooled, became thick and pappy. The pappy mass was then placed on a dry, porous stone, and put over sulphuric acid under a glass bell. After two or three days a snow-white mass was left on the stone; this was removed with a platinum knife for examination. The author estimated separately the sulphuric acid, the water, the nitrogen, the oxygen combined with nitrogen to form nitric oxide, and the excess. The numbers obtained led to the following as the formula of the crystals: $2\,SO_3 + HO + NO_3$. The author obtained the same product by the action of hyponitric acid on English sulphuric acid, and also by moist sulphurous acid and hyponitric acid.

II. ORGANIC CHEMISTRY.

Action of Chlorine on Anhydrous Acetic Acid.—M. Gal (*Comptes-Rendus*, t. liv. p. 570) passed a current of chlorine through anhydrous acetic acid heated to 100° C.: a part distilled leaving a crystalline mass in the retort. The crystals fused at 45° and at boiled about 185°. Their composition and properties corresponded to those of monochloracetic acid $C_4H_3ClO_4$. The liquid which distilled consisted of unchanged acetic acid and chloride of acetyl $C_4H_3O_2Cl$. According to this the chlorine is fixed without substitution, the acetic acid, however, splitting up to form with it the chloride of acetyle and monochlorocetic acid:—

$$C_8H_6O_6 + 2Cl = \left.\begin{matrix} C_4H_2Cl \\ H \end{matrix}\right\} O_4 + C_4H_3O_2,Cl.$$

The author thinks this is inconsistent with the constitution ascribed to acetic acid by Gerhardt. Wurtz, however (*Repertoire de Chimie Pure et Appliquée*, 1862, p. 179), reconciles it by supposing that an atom of chlorine removes one acetyle radical in the state of chloride, while a second atom of chlorine taking the place of an atom of hydrogen detached from the other acetyle radical forms monochloracetic acid, and he writes the equation thus:—

$$\left.\begin{matrix} \ddot{C}_2H_3O \\ \ddot{C}_2H_3O \end{matrix}\right\} O + Cl_2 = \ddot{C}_2H_3O.Cl + \left.\begin{matrix} \ddot{C}_2H_2ClO \\ H \end{matrix}\right\} O$$

MISCELLANEOUS.

Rice Glass from Japan.—C. T. writes from King's College as follows to the *Journal of the Society of Arts*:—"Among the curious objects in the Japanese Court of the International Exhibition, are some specimens which are exciting great curiosity, from the name given to them, viz., that of "rice glass." It has been stated in several journals that this glass is made from the albumen of rice, and wonder has been expressed as to the process by which so unpromising a material has been transmuted. I have examined the glass in question, and am prepared to say that it differs in no important particular from ordinary silicate of soda or potash. It is made from the sand obtained from the washing of the rice, and also, I imagine, chiefly from the husk obtained during the cleaning. The latter is particularly rich in silica, and that in a minutely divided state, admirably adapted for the wants of the glass maker, who has only to combine it with a due proportion of alkali, and raise it to the proper temperature to obtain a vitrified material."

Polytechnic Institution.—On Tuesday evening Professor Pepper delivered, at this excellent Institution, a brief but very interesting and instructive lecture in explanation of M. Serrin's new system of electric illumination. Having described the principle of the voltaic battery, and having drawn attention to the importance of applying that principle not only to scientific investigations, but to the practical purposes of every-day life, Mr. Pepper explained that many things had to be attended to, and numerous difficulties had to be overcome, before the light could be made automatic or self-acting, and in the perfect success with which that important point had been attained in M. Serrin's invention, the value of that invention might be said chiefly to reside. To be of any practical value, the charcoal points should work "automatically;" and of forty different systems which had been contrived from time to time, that of M. Serrin was the only one which satisfactorily fulfilled that condition. The inventor had received several high distinctions in his own country, and the prize medal had been awarded to him at the Great Exhibition. The lecture was followed by a series of ingenious and interesting experiments, which were conducted under the superintendence of M. Serrin himself, and afforded manifest gratification to a numerous company of spectators. Whether the lamp was placed upon the floor of the hall, or in the second, third, or highest gallery, the effect was in each case equally satisfactory, the electric light being invariably produced almost with the velocity of thought, and being turned with similar ease in a variety of opposite directions, and to all appearance rather by the mere volition of the operator than by any visible manipulation. The first experiment was a display of "naked light," very dazzling to the eye; the second was an exhibition of mellow light under a prismatic glass shade, constructed by Messrs. Defries, of Houndsditch; the third was a similar display under a ground-glass shade. The hall was then lit up with divergent rays thrown from a parabolic mirror. Rays nearly parallel were reflected from another mirror, and it was stated that they were carried a distance of three miles with such power that small print might be read with ease. The use of the electric light for signalling purposes on the field of battle was strongly insisted upon, as also was its applicability to submarine and mining operations, inasmuch as the light was shown to burn brilliantly under water, and in an atmosphere of carbonic acid. At the close of the lecture, the visitors were invited to view outside the building a brilliant imitation of a comet, produced by the projection of rays from a parabolic mirror. The column of light produced by this ingenious contrivance was very effulgent, and illumined Regent Street with a brilliancy which afforded not a little surprise to the passers-by. It is said that the commercial application of this new system of illumination is quite satisfactory, the battery used being Groves's, the cost of which does not exceed two shillings an hour.

ANSWERS TO CORRESPONDENTS.

X. Y. Z.—It is difficult to avoid the effect complained of. Try mixing the albumen with gum.

Chemicus.—The Royal College of Chemistry does not grant degrees. Certificates of attendance and of proficiency are given.

F. Day.—Dry carbonate of soda, not bicarbonate of soda, must have been meant.

A Constant Reader.—Some of our Numbers are out of print. Send up a list of those you want, and if they are in stock they shall be forwarded.

White Gunpowder.—Mr. Horsley begs to correct an inaccuracy; it should have been ferrocyanide or yellow prussiate of potash, not ferridcyanide.

THE CHEMICAL NEWS.

VOL. VI. No. 144.—September 6, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by FRANK H. STORER *and* CHARLES W. ELIOT.*

I. CHROMATE OF CHROMIUM ($Cr_2O_3CrO_3$).

1. When a solution of monochromate of potash is mixed with a solution of any ter-salt of chromic oxide, the mixture immediately becomes brownish-red, a bright brown precipitate subsides, and when this precipitate has been completely deposited, the liquid separated by filtration will present the clear yellowish-red colour of bichromate of potash. The chrome salt may be chrome alum, or sulphate of chromic oxide, or hydrated sesquichloride of chromium; and if a sufficient excess of chromate of potash be added to the solution, the precipitate and the filtrate will present the appearances described. This filtrate may be evaporated and crystallised; the resulting crystals will be a mixture of bichromate of potash and of sulphate of potash or chloride of potassium, as the case may be; often crystals of monochromate of potash will also present themselves. We prepared the precipitate for analysis by mixing a solution of chrome alum with an excess of monochromate of potash. The brown precipitate was washed with cold water; the colour of the wash-water, at first bright yellow, became gradually paler, but never colourless. Twice in the course of the seven days during which the washing was continued, the precipitate was transferred from the filter to a mortar, stirred up with water, and thrown upon a fresh filter. This process deepened the yellow colour of the wash-water in each case. It being quite evident that the colour of the wash-water was due to chromic acid abstracted from the precipitate, the washing was stopped on the eighth day, the precipitate was dried at 50° to 55°, and analysed as follows:—A portion was dissolved in very dilute nitric acid by the aid of a gentle heat; the colour of the solution was a red brown. Ammonia, added in very slight excess to this solution, kept at the boiling-point for half an hour, produced a brownish-green precipitate of chromic oxide, which looked the browner because it floated in a bright yellow liquid. This precipitate was filtered off and thoroughly washed with hot water; it then presented the common appearance of chromic oxide, and was ignited and weighed in the usual manner. The filtrate from this precipitate and the wash-waters were concentrated by evaporation, and acidified with acetic acid. Acetate of lead then precipitated the whole of the chromic acid contained in the yellow liquid, and after the subsidence of the precipitate the supernatant liquid was perfectly colourless. The chromate of lead was washed and weighed on a tarred filter as usual. The result of the analysis was—

CrO_3 = 16·27 per cent.
Cr_2O_3 = 46·43 ,,
Water = 37·30 ,, (by difference).

This examination showed, first, that the washed precipitate was a compound of chromic acid and chromic oxide; secondly, that it was more basic than any supposable definite compound of these two bodies; thirdly, that the prolonged washing removed chromic acid from the substance originally precipitated. To study the effect of the washing upon the precipitate, we prepared a considerable quantity of the brown precipitate by mixing a concentrated solution of pure chrome alum with a large excess of a concentrated solution of monochromate of potash. The precipitate as first collected upon the filter of course retained a considerable quantity of the bichromate of potash, chromate of potash, and sulphate of potash, which existed in the filtrate. The precipitate was quickly rinsed with cold water until these mechanically adhering salts seemed to have been removed. During this short washing, the substance underwent no change in colour or in any other external property. A portion was now removed from the filter, air-dried on a brick, and submitted to analysis (analysis *a*). The rest of the precipitate was washed for six hours with cold water; another portion was then taken from the filter, air-dried, and analysed (analysis *b*). Through the remainder (perhaps two teaspoonfuls) of the precipitate five litres of water were passed; another portion was then dried at 100° and analysed (analysis *c*). When dried at 100° the precipitate is much less readily soluble in dilute nitric acid than when not so heated, but the difficulty is easily overcome. The method of analysis was that described above.

Analyses.

	a.	*b.*	*c.*
	Per cent.	Per cent.	Per cent.
Cr_2O_3	39·69	45.26	65·17
CrO_3	22·42	15·12	8·87
HO (by diff.)	38·89	39·62	25·96

A comparison of these three determinations teaches that the abstraction of chromic acid by washing with cold water stops at no definite point, and probably has no limit except the complete change of the original precipitate into chromic oxide. The composition of the substance *a* must be a close approximation to the composition of the original precipitate, for the slight rinsing which was intended merely to remove the chromates belonging to the filtrate could hardly have abstracted much of its combined chromic acid. In the chromate of chromium whose formula would be $Cr_2O_3CrO_3$, the ratio of the chromic oxide to the chromic acid would be that of 3 : 2; and we find that the ratio of the chromic oxide to the chromic acid in analysis *a* is but little larger than that of 3 : 2. The substance *a* is probably, therefore, a chromate of chromium of the formula $Cr_2O_3CrO_3$, from

* Read before the American Academy of A and Sciences.

which a little of the chromic acid has been removed by washing.

Assuming for the present that the precipitate produced by the reaction of chrome alum on monochromate of potash is in truth this chromate of chromium, let us inquire into the nature of the reaction between these two salts by which this precipitate could be formed, and bichromate of potash left in the filtrate. Concentrated solutions of pure chrome alum and of pure monochromate of potash were prepared of known strengths, in order to determine the amount of either solution required to produce a precipitate to the other. A single drop of chrome alum solution produces an immediate and permanent precipitate in the chromate solution; but if the process be reversed and the solution of monochromate of potash be dropped into the alum solution, no permanent precipitate is formed till an apparently large excess of chromate of potash has been added. By accurate quantitative experiments we have proved that five equivalents of chromate of potash must be added to one equivalent of chrome alum to effect precipitation. If a less quantity be added, any precipitate which may form will at once redissolve when the mixture is made complete by agitation.† The reaction between the two salts may, therefore, be expressed by the formula,—

$$5\,(KOCrO_3) + KOSO_3,Cr_2O_3\,3SO_3 = 4\,(KOSO_3) + 2\,(KO_2CrO_3) + Cr_3O_3CrO_3,$$

and if to one equivalent of chrome alum more than five equivalents of chromate of potash be added, the excess above five remains inactive.

$$x\,(KOCrO_3) + KOSO_3,Cr_2O_3\,3SO_3 = 4\,(KOSO_3) + 2\,(KO_2CrO_3) + Cr_2O_3CrO_3 + (x-5)\,(KOCrO_3).$$

If any other normal salt of chromic oxide be used, a similar formula will express the reaction, thus :—

$$Cr_2Cl_3 + 5\,(KOCrO_3) = 3\,(KCl) + 2\,(KO_2CrO_3) + Cr_2O_3CrO_3.$$

$$Cr_2O_33SO_3 + 5\,(KOCrO_3) = 3\,(KOSO_3) + 2\,(KO_2CrO_3) + Cr_2O_3CrO_3.$$

With exact proportions of chrome alum and chromate of potash which are by the formula necessary for the precipitation of chromate of chromium, we prepared a quantity of the precipitate for a second series of analyses in corroboration of analyses *a*, *b*, and *c*. The precipitate thrown upon a filter was very slightly rinsed with cold water, a portion of it was taken off, pressed between folds of filter-paper under heavy weights, and air-dried for analysis (analysis *d*); the rest of the precipitate was washed for six hours till no trace of the filtrate could possibly be supposed to be retained by the precipitate, when another portion was taken out for analysis, pressed, and air-dried (analysis *e*); lastly, five litres of water were passed through the remaining precipitate, which was then dried at 100° and submitted to analysis (analysis *f*). The process of analysis was the same described above, and the results were as follows :—

Analyses.

	d. Per cent.	*e.* Per cent.	*f.* Per cent.
Cr_2O_3	38·85	44·01	59·83
CrO_3	25·91	19·88	13·43
HO (by diff.)	35·24	36·11	26·74

This set of analyses corroborates the first series in every respect, and the ratio of the chromic oxide to the chromic acid of the substance *d* is almost precisely the ratio 3 : 2 of the chromic oxide to the chromic acid in the chromate of chromium $Cr_2O_3CrO_3$. We again see that there is no definite limit to the removal of chromic acid by prolonged washing, and that the substance may be readily made more basic than any imaginable definite compound of chromic oxide and chromic acid would be.

(To be continued.)

† In this connection we would call attention to the inaccuracy of the statement made by Berzelius in his *Traité de Chime* (Paris, 1846, vol. ii. 307), to the effect that a compound whose formula is Cr_2O_3 $3CrO_3$ is precipitated when a few drops of the solution of monochromate of potash are added to the solution of a neutral chrome salt. No permanent precipitate whatever is produced under these circumstances, as any one may satisfy himself by repeating the simple experiment described above.

Notes on the Minerals Dysodile and Albertite, by Arthur H. Church, *B.A.*

In the Tasmanian Court of the International Exhibition several large masses of an unattractive looking mineral are exhibited, under the name of *Dysodile*, by the Dysodile Company. A large block may also be seen in the central case of the Museum of Practical Geology in Jermyn Street. The specimen is there labelled as "Combustible Matter from the Banks of the River Mersey, North side of Tasmania," and was presented by Sir W. Denison. The name "Dysodile" is assigned to a rare mineral in Chapman's "Mineralogy;" but I have had no opportunity of ascertaining whether that substance is identical with the Tasmanian specimen, although it is highly probable that they nearly resemble one another.

Dysodile presents the appearance of a brownish-grey slate, or of a non-bituminous shale, rather than that of any kind of fuel; yet it burns freely when held in a flame, diffusing, however, a most offensive odour; it is also extremely soft. It has been employed in the locality where it occurs in place of coal. The stratum of the mineral is of great thickness.

This curious mineral is not of very uniform composition; for, when examined with a low magnifying power, the combustible constituent of dysodile is seen to be disseminated pretty uniformly throughout the substance of a grey shale in the form of small flattened drops of a pale brownish-yellow colour, and marked with a few ridges radiating from the centre of each disc. When a piece of dysodile is carefully crushed in a mortar, and the fragments then warmed with strong hydrochloric acid, these discs float in the liquid, and may be easily separated. They are nearly, if not quite, insoluble in ether, alcohol, and benzole,—thus differing from solid paraffins; they require a high temperature for their fusion, and have been found to contain a small percentage of oxygen, though nearly made up of carbon and hydrogen, in the proportion of 1 : 2.

Dysodile in its native state can scarcely be termed "combustible matter." It consists mainly of a silicate of alumina, but contains also some quantity of iron, and a trace of soda. By far the larger part of it is incombustible and inorganic, as the following approximative analysis shows :—

Carbon and hydrogen as determined by a combustion	36·51
Water, &c., being the loss sustained at 200° C.	2·30
Ash, containing silica, alumina, iron, soda, lime, &c.	61·19
	100·00

Albert Coal, or Albertite.—A beautifully lustrous and intensely black substance is exhibited, under the name of Albert Coal, in the New Brunswick Court. It occurs at Hilsborough, Albert County, N.B. Albertite presents the general appearance of a very excellent cannel-coal, and breaks with an extremely brilliant, conchoidal, vitreous fracture. Its jet black powder, when heated in an open vessel, partially melts, and then gives

off continuously a large volume of combustible vapour, leaving a light and bulky coke. This vapour burns with an intensely smoky flame. But there is one point to be noted here of considerable interest: the coke which Albert coal leaves is nearly pure carbon, there being, in fact, speaking practically, no ash in Albertite, as the following result proves:—

1·55 grammes left ·001 of ash.

This is equal to no more than ·0645 per cent., which we believe that no cannel-coal or anthracite hitherto analysed contains so little as 1·0 per cent. of ash. Among its volatile constituents, Albertite contains scarcely determinable traces of nitrogen and sulphur.

Accompanying the Albert coal, there may also be found in the New Brunswick Court some very pure and pale-looking specimens of oil produced by its destructive distillation. As might be expected from the almost entire freedom of the mineral from nitrogen and sulphur, these oils are almost without offensive odour, and are, moreover, admirably adapted for burning in paraffin lamps. They are not capable of forming an explosive or inflammable vapour, and the light they give is brilliantly white.

A sample of oil submitted to fractional distillation did not commence to boil until the thermometer had risen to 170° C., while only half the oil had come over at 270° C., one-seventh, or even more, remaining in the retort when it had been raised to the boiling point of mercury. This residue did not show any traces of crystals when cold.

It is to be regretted that the discovery of an abundant supply of native mineral oil has caused the manufacture of Albertite oil to be discontinued.

On the Chemical Examination of Iron Samples, and of the Materials employed in their Manufacture, by* F. A. Abel, *Esq., Chemist of the War Department.*

In conducting a large series of analytical examinations of a quantitative character, which have been undertaken, not simply to furnish results of scientific interest, but with a view to be of use in considerations of a practical character, it is not only admissible, but necessary that some discrimination should be exercised in determining the extent of detail of such examinations, so that, on the one hand, a proper knowledge be obtained of the proportions of all the important and characteristic components of a substance, while, on the other hand, no great unnecessary expenditure of time and labour be incurred in researches on the existence or proportions of constituents which occur in minute quantities in the substances examined, and have not yet been discovered to exert any influence on its chemical or physical character.

Thus, the existence in cast iron of metals, such as titanium, calcium, magnesium, nickel, copper, lead, &c., has been traced by minute analyses of various samples by different chemical authorities, and the proportions in which they occur have also frequently been determined; but it is only when some foreign metal, such as copper, lead, or arsenic, has been found to exist in a sample of cast iron in a larger proportion than usual, that it has been proved to exert some marked and well-established influence over the character of the metal.

It may, therefore, be safely inferred, in the present state of our knowledge, that modifications in the properties of cast iron are not dependent upon the presence or absence of minute proportions of such foreign metals, and that researches having in view the discovery or the determination of the proportions of these constituents, do not at present possess any practical interest, and are only advisable:

1. In conducting analyses of specimens of peculiar interest for purposes of scientific record.

2. In undertaking special researches with a view to ascertain whether, and to what extent, these constituents influence the properties of cast iron.

Such researches as those last referred to are unquestionably of great interest, and, if pursued to a sufficient extent, may possibly lead hereafter to important practical results. Their objects differ, however, from those of the investigation the results of which are embodied in this Report, and which was undertaken with a view to ascertain, by an application of our present knowledge of the chemical and physical properties of cast iron, the relative qualities of various descriptions of pig iron submitted by numerous manufacturers.

There is no question, however, that it is in most instances very important to perform complete analyses of materials which are to be employed for the extraction of metals; for as these, at the high temperature necessary in the process of their reduction from ores, are endowed with powerful affinities for many of the frequent constituents of such ores, their properties will suffer more or less important modification by union with some of these components in the course of their reduction.

The quality of the product may therefore be, to some extent (when the treatment is under control), predicted from the results of a complete examination of the materials employed. It is, consequently, not only essential to ascertain the general composition of an ore, for the purpose of determining the nature and proportions of the auxiliary materials (fluxes) to be associated with it in the reduction process, but it is also of considerable importance to ascertain whether, and in what proportions, such constituents (as foreign metals, sulphur, and phosphorus) are contained in the ores, as are likely to enter into the composition of the product and exert an influence upon its properties.

In the chemical examination of the large series of iron samples and materials employed in their manufacture, the system of analysis adopted has been based upon the principles embodied in the foregoing remarks.

The analyses have been performed by Mr. John Spiller, formerly chemical assistant at the Royal College of Chemistry, and subsequently at the Government School of Mines, and Mr. Arthur Reynolds, late an assistant at the College of Chemistry.

The samples of ores received from the manufacturers have been all submitted to complete analysis, excepting in the following instances:—

1. In one or two cases where the samples were found to be identical in character with some of the series of ores recently submitted to complete analysis at the Government School of Mines, under Dr. Percy, the results of which have been published in the "Memoirs of the Geological Survey of Great Britain."

The close resemblance of the samples to those above alluded to was established by a comparison with the descriptions given of the ores in the Government Report, by a careful examination of them made by Mr. Spiller, who performed a large number of the analyses alluded to in that Report while at the School of Mines, and was well acquainted with all the specimens examined; and lastly, by a determination of the most important con-

* Report of Experiments on British Irons, Ores, &c., for the Manufacture of Cast Iron Ordnance.

stituents of the samples received (*e.g.*, the oxide of iron and phosphoric acid), and a comparison of the results with those of the published analyses.

In these instances, as a complete analysis of the samples would have involved a very considerable unnecessary expenditure of time, it was not undertaken; but the detailed analyses of the ores, to which the samples corresponded, have been extracted from the Government Report.

2. A few of the ores received had been submitted to the roasting process. As the effect of this treatment of an ore is greatly to modify its original composition, partially expelling certain constituents, and altering the arrangement and state of combination of others, a detailed analysis would afford no correct indication of the original nature of the ore. In such instances, therefore, it was only considered important to determine the per-centages of iron and of those constituents which might affect the quality of the metal obtained from the ore—the phosphoric acid and sulphur.

3. The ores sent by some manufacturers were identical in their nature with those from other works, and of which complete analyses have been made. In these instances the most important constituents of the samples in question have alone been determined, references having been made when needful to the full analyses.

The minerals employed as fluxes were all submitted to complete analysis, except in one or two instances, when their identity with samples already analysed was established by the determination of one or two constituents.

The examination of the fuel was partial, the only important object being to determine to what extent it might contain mineral matters possibly prejudicial to the quality of the metal reduced by its means. The examinations therefore included determinations of the amount of sulphur in the coal or coke, and the amount and character of the ash furnished by incineration. It was also considered interesting to determine the amount of coke furnished by the different samples of coal.

The analyses of the samples of iron were, for the reasons already stated, limited in most instances to the determination of the proportions of those constituents which have already been satisfactorily proved to exert some influence on the quality of the pig iron, or on the results obtained by submitting it to subsequent processes of manufacture.

The constituents in question are manganese, silicon, phosphorus, sulphur, and carbon.

With reference to the last-named substance, it may be necessary to observe, that almost all the specimens of pig iron examined which are included in this Report were varieties of grey iron, and that but very few of the samples contained any appreciable amount of carbon in the combined form.

It was, therefore, of no importance or interest to determine the minute portions of carbon existing in the samples in the latter form, and this was proved by special examinations of a few of the light grey samples of the series, in which the amount of combined carbon was not found to exceed at highest 0·35 per cent.; and also by the determination of the total amount of carbon in a sample of No. 1 pig iron, the result obtained being identical with that afforded by the direct estimation of the carbon existing as graphite.

In two or three instances it was considered interesting to examine specially for certain foreign metals which had been found to exist in appreciable quantities in some of the ores from which the samples thus examined had been obtained.

Description of the Analytical Processes employed in the Chemical Examination of the Irons, Ores, Fuels, and Fluxes.

I.—Analyses of the Iron Samples.

Preparation of the Sample.—Preparatory to its examination, the metal was reduced to a suitable state of division by boring, turning, or planing. In the case of white iron it was broken to a coarse powder in a steel crushing mortar. It was considered preferable to prepare an average sample of the pig by boring across it, so that a fair proportion of the graphite, which was occasionally concentrated towards the centre of the pig, might be included in the sample. The fine borings obtained in this way were further reduced when necessary, and thoroughly mixed by trituration in a Wedgwood mortar.

Chemical Analysis.—In the analysis of pig iron the proportion of the following constituents were usually determined: manganese, carbon, silicon, sulphur, phosphorus, and, in certain cases, metals such as arsenic, lead, and copper, when their existence in appreciable quantity had been discovered in the ores from which the iron had been obtained.

For this purpose four portions were usually weighed out:—

a. 100 grains, for sulphur, carbon existing as graphite, silicon, and manganese.

b. 50 grains, for phosphorus.

c. 50 to 100 grains, for determining the existence and amount of combined carbon.

d. 500 grains, for metals existing in the iron in minute proportions.

Sulphur.—100 grains of the iron borings were slowly dissolved in concentrated hydrochloric acid, the evolved gas being passed through a solution of acetate of lead, slightly acidified with acetic acid, the sulphuretted hydrogen, disengaged together with hydrogen, precipitated the sulphide of lead, which was collected on a filter, washed, burnt, and subsequently (in the customary manner) converted into sulphate of lead, from the weight of which the per-centage of sulphur was calculated.

The contents of the flask, after the metal had been fully acted upon, were transferred to a porcelain basin and evaporated to dryness, the mass digested with concentrated hydrochloric acid, and water afterwards added. The insoluble residue, consisting of silicic acid and graphite, was collected on a filter, the filtrate being reserved for the estimation of manganese.

Carbon, as Graphite.—The mixed silicic acid and graphite were separated by the action of a warm solution of pure potassa, when the silicic acid was dissolved, the graphite which remained insoluble was again collected, washed with dilute hydrochloric acid and water, and dried. It was afterwards carefully removed from the paper by scraping with a knife blade, and transferred to a platinum crucible, in which, after exposure for some time to about 300° F., it was weighed. Upon subsequently burning the graphite in a muffle, it usually left a very small quantity of reddish ash, which was deducted from the former weight.

Silicon.—The amount of silicic acid, dissolved by the potassa, was recovered in the usual manner, by evaporation with hydrochloric acid; the residue was digested with water, collected, washed, dried, and weighed. The

amount of the silicon in the iron was calculated from the silicic acid obtained.

Manganese.—The hydrochloric acid solution, separated from the silicic acid and graphite, was divided into two equal portions, one of which, representing 50 grains of iron, was always sufficient for the estimation of the manganese. The iron in the liquid having been peroxidised by boiling the hydrochloric acid solution, and adding occasionally a little chlorate of potassa, the acid was to a great extent neutralised by addition of carbonate of ammonia. Sufficient acetate of ammonia was afterwards added for the conversion of the chloride of iron into acetate, and the liquid was boiled, when the iron was completely separated as insoluble basic acetate. The filtrate containing the manganese was rendered alkaline with ammonia, and, after the addition of a few drops of bromine, set aside for about eighteen hours. The hydrated binoxide of manganese which had separated from the liquid, was afterwards collected, washed, dried, and ignited at a high temperature, when it was weighed as manganoso-manganic oxide (Mn_3O_4), which furnished, by calculation, the quantity of manganese.

(To be continued.)

Effect of Powdered Ice in Water Boiling in Glass Vessels, by Professor P. A. Chadbourne, *of Bowdoin College.*

The common experiment of pouring iron filings into water slowly boiling in smooth glass vessels to increase the ebullition, can be instructively varied by substituting powdered ice or granular snow for the iron filings. Snow that has thawed partially and then frozen so as to become hard and granular is the best; but powdered ice will answer, if kept so cold by freezing mixture as to be perfectly dry. If a spoonful of this ice or snow be thrown into a smooth flask nearly filled with water slowly boiling, intense ebullition at once takes place, a portion of the water being thrown out of the flask. The particles of ice thus act like particles of iron or sand, before they have time to melt and set free the steam.—*American Journal of Science.*

TECHNICAL CHEMISTRY.

On Steam-Boiler Explosions.

The Decomposed Steam Hypothesis.—The unsatisfactory results generally obtained by those who have sought to decompose water by heat on a large scale, with the view of applying its elementary gases separately, does not appear to have prevented the occasional adoption of the hypothesis that, in certain cases, all the steam contained within a boiler is decomposed, and its hydrogen (by some means not easily explained) exploded with great violence. That steam, passed over pure metallic iron heated to redness, is decomposed, is perfectly true, although the iron must retain all the oxygen separated in the operation. With oxidised iron, however, the process of decomposition cannot be continued. This is, we believe, a chemical fact of which there can be no dispute. To decompose 1 lb. of water (or steam, which is chemically the same substance) 14·2 oz. of oxygen must be fixed by the iron, and only 1·8 oz. of hydrogen will be set free. This large proportion of oxygen, absorbed by only a few square feet of over-heated surfaces, would soon form an oxide of iron of sufficient thickness to arrest all further decomposition, and all the hydrogen up to that time disengaged would not amount, perhaps, to 1 lb. in weight. By itself, or mixed with steam, hydrogen cannot be exploded, nor even ignited. It will extinguish flame as effectually as would water.

Upon this subject we may refer to a report made by Professor Faraday in May, 1859, to the Board of Trade, upon the liability to accident consequent upon the introduction of an apparatus for superheating steam on board the Woolwich steamboats. In this apparatus the steam was carried in iron pipes immediately through the furnace, and in contact with the incandescent fuel. Professor Faraday, after having examined the apparatus at work, says:—

"I am of opinion that all is safe, *i.e.*, that, as respects the decomposition of the steam by the heated iron of the tube and the separation of hydrogen, no new danger is incurred. Under extreme circumstances the hydrogen which could be evolved would be very small in quantity—would not exert greater expansive force than the steam—would not with steam form an explosive mixture—would not be able to burn with explosion, and probably not at all if it, with the steam, escaped through an aperture into the air, or even into the fire-place.

"Supposing the tubes were frequently heated over much, a slow oxidation of the iron might continue to go on within; this would be accompanied by a more rapid oxidation of the exterior iron surface, and the two causes would combine to the gradual injury of the tube. But that would be an effect coming under the cognizance of the engineer, and would require repair in the ordinary manner. I do not consider even this action likely to occur in any serious degree. I examined a tube, which had been used many months, which did not show the effect; and no harm or danger to the public could happen from such a cause."

Professor Taylor, of Guy's Hospital, reported in part, as follows, upon the same apparatus:—

"It is true that steam passed over pure metallic iron heated to redness (1000°) is so decomposed that the oxygen is fixed by the iron while hydrogen gas is liberated. This chemical action, however, is of a very limited kind. The surface of the iron is rapidly covered with a fixed and impermeable layer of the magnetic oxide of iron, and thenceforth the chemical action is completely arrested. If the interior of an iron pipe has been already oxidised, by passing through it, while in a heated state, a current of air, there will be no decomposition of steam during its passage through it. If the interior of an iron pipe were not thus previously oxidised, it would speedily become so by the oxygen derived from the air, which is always mixed with steam. Hence, chemically speaking, under no circumstances, in my opinion, would any danger attend the process of superheating steam as it is conducted under this patent. It is proper, also, to state that hydrogen is not explosive, but simply combustible, and assuming that it was liberated as a result of the decomposition of superheated steam, its property of combustibility would not be manifested in the midst of the enormous quantity of aqueous vapour liberated with it and condensed around it. There could be no explosion, inasmuch as hydrogen, unless previously mixed with oxygen, does not explode; and oxygen is not liberated but actually fixed by the iron in this process. It is a demonstrable fact that the vapour and gas evolved under the form of superheated steam, tend to extinguish flame and to prevent combustion from any other cause."

Professor Brande, in a report made by him to the patentees of the same apparatus, observes:—

"In reference to the question which you have submitted to me, respecting the possible or probable evolution of hydrogen gas and consequent risk of explosion in the processes, and by means of the apparatus which you employ for the production of superheated steam, I am of opinion that there can be no danger from such effect, that the temperature to which the iron pipes connected with your boiler are raised, and the extent of the iron surface over which the steam passes, are insufficient for its decomposition; and that if the temperature of the pipes were even raised considerably beyond that which you employ, or would be able to attain, a superficial layer of oxide of iron would line the interior of the heated pipes, and so prevent any continuous decomposition of water. Effectually to decompose steam, by passing it over iron, it is necessary that a very extended surface of the metal (as in the form of thin plates or iron turnings) should be used, and that the temperature should be continuously maintained at a bright red heat, namely, at a temperature considerably above 1000° F. I have read Dr. Taylor's report, and entirely agree with the inferences he has drawn as to the absence of danger from the evolution of hydrogen gas in practically carrying out your process for the production and application of superheated steam."

The practical conclusions upon this subject are the following:—1. Decomposition cannot possibly occur, to any considerable extent, under any circumstances arising in the working of ordinary steam boilers. 2. If it did occur, the hydrogen thus liberated would have no access to oxygen, without which it could neither inflame nor explode. 3. Even if oxygen were present, the presence of steam would prevent ignition. 4. If oxygen were present, and no steam existed in the boiler, the hydrogen would only inflame and burn silently as fast as it was produced, the heat for ignition being supposed to come from a red-hot plate. Under these accumulated impossibilities of violent explosive action, the explanation of boiler explosions by the decomposition of steam is without any support whatever.

Electro-Chemical Reduction of Cobalt, Nickel, Gold, Silver, and Platinum, by MM. BECQUEREL *and* ED. BECQUEREL.

HAVING lately renewed the study, first undertaken more than thirty years ago, of the electro-chemical phenomena produced by electric forces of feeble intensity, we commenced with the reduction of metals and the aggregation of their particles by the use of certain solutions. This reduction is of such importance in chemistry and industrial applications, that researches with the view of extending the action by means of which it is obtained cannot fail to prove interesting.

We will now point out the results obtained with solutions of cobalt, nickel, gold, silver, and platinum.

Cobalt.—This metal is obtained sufficiently pure by submitting to the action of a very weak electric current a concentrated solution of chloride of cobalt, with the addition of caustic ammonia or potash sufficient to neutralise the excess of acid. The metal is deposited in small coherent tubercles or in uniform layers, according to the weakness of the current. It has a brilliant white colour, rather similar to that of iron. During the decomposition, part of the chlorine is disengaged, the other remaining in the solution in the state of hydrochloric acid. It happens that the solution momentarily becomes so acid that the deposit loses its metallic brilliancy, taking a blackish colour; but the brilliancy is regained by saturating the excess of acid with alkali, and preferably with ammonia. The intensity of the current necessary to obtain a coherent deposit is always connected with the density of the liquid to be decomposed.

The cobalt obtained is hard and brittle. Re-heated at the proper temperature in hydrogen gas, it becomes very malleable and can be worked. In moulds properly prepared, cylinders, bars, and medals can be formed of it. With a positive electrode of cobalt, it is unnecessary to touch the solution after its first preparation.

When the solution contains salts of lead and manganese, they are decomposed and deposited as peroxides on the positive electrode. The greater part of the iron remains in the mother-waters, as traces of it only can be found in the metallic deposit, which is then in a sufficiently pure state. The cylinders and bars taken from the solution are not only magnetic, but possess the polarity due to the action of the current or to that of the earth.

Nickel.—We operate with a solution of sulphate of nickel, to which is added caustic potash, soda, or ammonia, with preference for the latter, to saturate the excess of acid, as with the chloride of cobalt. The current employed to reduce it should be of nearly the same intensity as that used for the cobalt.

The sulphuric acid becoming free, we saturate it with oxide of nickel placed at the bottom of a vessel, or by adding alkali to the solution, giving preference to ammonia. In the first case, the solution remains at the same degree of concentration; in the second, it deposits clear green crystals of double sulphate of nickel and ammonia, very slightly soluble in water, but soluble in water containing ammonia. These solutions are utilised, as we shall see.

After a certain time a brilliant white metallic deposit is obtained, with a slight yellowish tinge, from which, as with cobalt, cylinders, bars, and medals can be moulded. The first can be fashioned to various uses. When taken out of the solution, and before being re-melted, they possess magnetic polarity as well as cobalt.

The ammoniacal solution of double sulphate of nickel and ammonia, and even that which is not ammoniacal, also yield metallic nickel. In fact, it always remains at the maximum of concentration by putting at the bottom of the vessel a certain quantity of double sulphate; but the sulphuric acid becoming free during the decomposing action of the current, we saturate it with ammonia, in which case the method employed is similar to that usually adopted to obtain a galvanic deposit of metallic iron.

Gold.—A solution of chloride of gold, as neutral as possible, and highly concentrated, gives remarkable results. Taking a gold wire as a positive electrode, and operating with one pair of very feeble electro-motive power, the gold is rapidly reduced and easily moulded on the negative electrode. Re-melting renders it ductile. It is then unnecessary to use alkaline solutions to obtain a malleable deposit, but the intensity of the current must be proportioned to the density of the liquid to be decomposed. The only difference is in the time taken to effect the deposit.

Silver.—It is the same thing with silver. A highly concentrated solution of the nitrate of this metal, as neutral as possible, is easily decomposed, with adherence of the metallic parts, by an electric current of sufficiently feeble intensity. The positive electrode of silver is indispensable to the success of the experiment.

Platinum.—There is more difficulty in aggregating the particles of platinum than those of the before-mentioned metals. It is necessary to employ a neutral and concentrated solution of this metal, a platinum wire as negative electrode, round which the metal deposits itself, frequently in the form of small tubercles.

Speaking generally, it may be said that in decomposing concentrated metallic solutions, whatever their composition, with currents of very feeble intensity, and according to the density of the solution, confused deposits are avoided, the molecules grouping themselves regularly or aggregating and adhering. This principle has enabled us to reproduce numerous mineral substances by electro-chemical decomposition.

We intend publishing another memoir on the results of our researches on the reduction of other metals, with difficulty obtained pure by the ordinary chemical methods.

PHARMACY, TOXICOLOGY, &c.

On Albuminate of Iron and Soda as a Therapeutic Agent, by Angelico Fabri.

Simple contact, at the ordinary temperature of the atmosphere, of white of egg with a salt of iron and soda, is capable of instantly producing a soluble albuminate of iron and soda, or an albuminferrate of the alkaline base. The chemical combination of this compound is such that it is not altered by the yellow ferrocyanide of potassium, the most delicate test of the salts of iron, unless a few drops of acid—as, for example, hydrochloric—be previously added to the soluble albuminate, thus proving that this decomposition cannot be effected by the agency of the alkalies, but only by some acids, since the potassium of the cyanide is not able to displace the oxide of iron, becoming oxidised at its expense, and setting the metal free, as occurs with the other ferruginous preparations. Considering that we find in the blood albumen, soda in excess, and iron, and having shown how these three bodies, by simple direct contact, form a soluble salt, the chemical combination of which is so powerful that it is not destroyed by the most delicate reagent, may we not fairly infer that the iron exists in the blood as an albuminate of iron and soda? and would it not, therefore, be reasonable to administer iron in the various diseases in which it is prescribed, principally in reference to the state of the sanguineous system, in the form of albuminate, as that in which nature itself has placed it within our organism—one of the products, so to speak, on which our life depends? When I read in works of chemistry that the yellow ferrocyanide of potassium is not capable of demonstrating the presence of iron in the blood until a stream of chlorine has first been passed through the latter to destroy its colouring matter, I am confirmed in the opinion that the iron exists in that fluid as an albuminate of iron and soda, because this salt, requiring the addition of an acid to render it capable of detection by the cyanide, is supplied with it by the chlorine, which, in destroying the organic colouring matter, becomes converted into hydrochloric acid by uniting with their hydrogen. Physicians have been long puzzled, and are still at a loss, how to administer iron, a valuable remedy, in the manner most suitable to the internal organism; hence the great number of preparations of this metal. Some object to its saline combination with mineral acids on the ground that these are inorganic, and they prefer giving it in the metallic or oxidised state, leaving the acids of the stomach to form with it compounds which may be carried into the circulation. Others, unwilling to run the risk of having the greater part of the iron—little or not at all acted upon—expelled with the fæces, prescribe it in the saline state, but combined with organic vegetable acids; hence we have the malate, tannate, citrate, &c., of iron. Others, still more scrupulous, wish to have it united to acids of an animal nature, and prefer the lactate, the cyanide, &c.; and I, going still further, would recommend its employment in the state of albuminate of iron and soda, requesting physicians to take into consideration what I have advanced, and to ascertain if practice will in this instance corroborate theory.

In preparing the albuminate of iron and soda I employed the following process:—Take 112 grains of caustic soda, and 104 of sulphate of iron. Having dissolved both in a sufficient quantity of distilled water, let the solutions be poured on the whites of four eggs previously beaten up; let all now be shaken together and poured upon a filter to separate the hydrated oxide of iron which has precipitated, since all the iron is not in this case converted into albuminate. To the filtered liquid, which now contains, in addition to the albuminate, sulphate of soda, formed by the decomposition of sulphate of iron by the soda present in excess, lime water is to be added to decompose the sulphate of soda, by which an insoluble sulphate of lime is precipitated. To separate the latter, the mixture is to be again filtered; and as the filtered fluid will contain an excess of lime, it is to be subjected to the action of a stream of carbonic acid, care being taken to avoid using an excess of the latter, and again filter to get rid of the insoluble carbonate of lime thus formed. The filtered fluid is now to be allowed to evaporate in a wide, shallow vessel, and with the aid of the heat of a stove until it is reduced to a pint. A clear orange-yellow, slightly saltish, chalybeate solution is thus obtained, which, as already mentioned, does not give a precipitate with ferrocyanide of potassium without the addition of an acid. Each ounce of this liquid contains, approximately, four grains of the albuminate, *plus* an excess of albumen and soda, as may be seen by referring to the process employed; the solution, consequently, has a slightly alkaline reaction. It is desirable that the soda should thus be present in excess, in order that the compound shall be conformable to the state in which it exists in the blood, where we find the albumen rendered alkaline by an excess of soda.—*Journal of Rational Medicine.*

On the Detection of Picrotoxine, by John W. Langley, *S.B.*

The seeds of the *Menispermum Cocculus*, known in commerce by the name of Cocculus Indicus, or popularly as "Fish berries," contain several active organic bodies. One of these, picrotoxine, is eminently poisonous, and, it has been asserted, possesses in small doses a distinctly intoxicating quality. From this cause, and because the addition of the berries to the fermenting mash enables the brewer to dispense with a large amount of the malt which he would otherwise use, they have been largely employed for the adulteration of ale and beer, so much so, in fact, that it was deemed necessary in England to pass a law prohibiting its use for this purpose. While the composition and properties of picrotoxine have been long known, no process has been hitherto discovered by

which it may be detected with certainty and confidence, the only method now employed being the recognition of its crystals under the microscope.

When picrotoxine obtained by any of the methods usually given for its preparation is examined, it will be found to possess the appearance and many of the properties of the alkaloids with which it has been classed; but it differs from them in the essential particular of not combining with acids, but, on the contrary, it manifests a decided affinity for bases, and behaves in many respects like a weak acid. Again, it differs from them in the fact that if a salt of an alkaloid is decomposed with potassa, we can remove the organic base by ether from an aqueous solution, while the same course pursued with picrotoxine would fail to remove any of it from the water, it being positively necessary that the solution should be neutral or acid, to enable the ether to dissolve it.

Picrotoxine is soluble in 150 parts of cold water; but if a small quantity of caustic alkali is present it will readily dissolve in six or eight times its volume. When this solution is gently heated it becomes yellow, and on platinum foil, at a temperature far below ignition, assumes a brick-red colour, which is distinctive and quite unlike the shade produced by sugar under similar circumstances. Picrotoxine, like sugar and many indifferent organic bodies, possesses the property of reducing certain metallic oxides. "It changes bichromate of potass to a fine green colour." (Gmelin.) "An alkaline solution of picrotoxine reduces sulphate of copper to the suboxide." (Otto.) This property, however, is common to too many other substances to be at all distinctive. A far more reliable test is found in oxidation.

If dry picrotoxine and nitrate of potassa are rubbed together in a watch-glass, and a drop of sulphuric acid is added, no perceptible change occurs; but if a strong solution of caustic soda or potassa is poured upon this, a bright reddish-yellow colour is communicated to the mixture, which partially dissolves and causes the whole liquid to assume the same tint. In this way very minute traces of picrotoxine may be discovered, so small a quantity as $\frac{1}{5000}$th of a gramme, if pure, being detected with the greatest ease. When as small a quantity as this is used, we see the colour most distinctly by gently breaking the solid cake of sulphate of potassa which lies on the bottom of the dish; portions of the precipitate will then appear of a crimson or purple hue.

In applying this test, it is best to add about three or four times the quantity of nitrate of potash that we have of substance to be examined, and to use no more sulphuric acid than is necessary to moisten the mass. The solution of potassa or soda should be made very strong, and enough added to ensure considerable alkalinity in the mixture after the neutralisation of the sulphuric acid.

Other powerful oxidising agents will produce the same result, but not with equal facility; chlorine passed over the moistened crystals slowly dissolves them, and if we pour the alkaline solution upon them, we obtain the same colour, or we may substitute chlorate of potassa for the nitrate; the objection to the use of this, however, will be found in its tendency to explode when coming in contact with the acid.

This colour, however produced, is not permanent, but will slowly disappear with a rapidity proportioned to the amount of substance taken, but it will always appear with great distinctness when first adding the alkaline solution, if any picrotoxine is present.

It is extremely probable that this colour is produced from a trace of some nitrogenous body which pertinaciously adheres to the picrotoxine, as, on analysis, traces of nitrogen can be detected; but this body powerfully resists all attempts at separation, for when repeatedly crystallised the picrotoxine still retains a minute portion of it. It can be obtained perfectly free from nitrogen only by dissolving it in potassa and precipitating it by acids. When thus prepared, its properties are the same as before, with the exception of the purple colour produced by oxidation and subsequent treatment with alkalies.

There is no substance at present known to the writer which gives this shade of colour under these circumstances. There are two, however, which communicate a brownish-yellow to the fluid, and would, if present as an impurity, interfere with the distinctness of the reaction: these are sugar and strychnia; from the first we need suffer no inconvenience, as it is perfectly separated in the ordinary method used for isolating the alkaloids; from the latter, picrotoxine is most completely removed by treating an acidulated aqueous solution of the two bodies with ether, the strychnia remaining as a salt dissolved in the water, and the ether containing all, or nearly all, of the picrotoxine. To prove this, the following experiment was tried:—A quart of ordinary ale was divided into equal portions; into one ·045 grm. of picrotoxine and a little strychnia were introduced; the other was unadulterated; both were acidulated with hydrochloric acid, and agitated with ether; the ethereal solutions on evaporation yielded, in the first case, small microscopic crystals of picrotoxine mixed with a little extractive matter perfectly free from strychnine; the other yielded extractive matter alone. The test of sulphuric acid and nitrate of potash was then applied; the brownish-red colour was produced in the first case; in the second there was no change. To ascertain the readiness with which minute quantities of picrotoxine can be detected, $\frac{1}{50}$th of a gramme of it was dissolved in a pint of ale; this was acidulated and treated as above; the ethereal extract furnished ample proof of the poison when tested.

In another experiment the stomach of a cat which had been poisoned was emptied of its contents, so that only the picrotoxine absorbed by the coats of the stomach might be extracted. It was treated with alcohol, and the solution evaporated to dryness. Acidulated water being poured on the residue, the picrotoxine and a little organic matter were dissolved; being now treated with ether, and the solution evaporated, small crystals of picrotoxine were obtained, which, when tested, produced the characteristic red colour. A portion of animal matter free from poison treated in the same way gave no discoloration.

In examining a liquid for picrotoxine, it should first be rendered acid, then shaken with ether; the residue left on evaporation of the ether examined with the microscope for small prismatic crystals; if a few drops of sulphuric acid diluted with its volume of water are added in the cold, and there are alkaloids present, they will dissolve, only so much picrotoxine passing into solution as is due to the water present,—about one part for 150 of water. A few drops of an alkaline fluid will dissolve the crystals, and on applying heat the fluid will become first yellow and when strongly heated will become brick-red. A small portion ground in a watch-glass with nitrate of potassa and sulphuric acid gives a solution which, when rendered alkaline by potash or soda, becomes a bright red.—*American Journal of Science.*

University of Michigan, Ann Arbor.

INTERNATIONAL EXHIBITION.

Class I.

Mining, Quarrying, Metallurgy, and Mineral Products.

(*Continued from page* 106.)

As we have said, Mr. M'Culloch was wrong when, in the fourth edition of his "Statistical Account of the British Empire," published in 1854, he said that we could not boast of mines of gold and silver. Scotland had long produced gold, and here, in Case 166, Mr. Irving now exhibits small specimens from the Lanarkshire mines, which, he informs us, yielded, in 1542, enough of the metal to make the Scottish regalia. These mines are now only worked for lead (and beautiful specimens of native chromate of lead will be seen in Mr. Irving's case), but every now and then a small nugget of gold turns up, and great excitement, followed by great disappointment, ensues.

In 1844, it was announced that auriferous veins existed in the Snowdonian range in North Wales, and small quantities of the metal were obtained by the amalgamation process; but more, it was afterwards proved, was thrown away than was extracted. Since then Professor Ramsay, and later, Mr. Readwin, have examined the district, and the last gentleman has succeeded in obtaining gold in considerable quantity, specimens of which he exhibits in Case 295. Gold, and the ores from which it is separated, are also shown by the Vigra and Clogau Copper Mining Co. (383). The history of these and the Dolfrw-y-nog mines, we believe, would show that they have passed through many vicissitudes. They have been worked for copper and abandoned again and again; and most experienced "captains" have described them as valueless. When it was first said that gold existed in them, many people laughed, and when the gold was exhibited they said something about "Dousterswivels." Now, however, the fact of the metal being present in considerable quantity is placed beyond a doubt by the specimens exhibited, and we read in the *Mining Journal* that in the first six months of the present year, 3537 ounces were obtained from 434 tons of ore, which is at the rate of eight ounces of gold to the ton,—a yield which is greatly above the average amount obtained by crushing quartz in Victoria. The metals found with the gold in the Welsh mines are said by Mr. Readwin (see Chemical News, vol. iv. p. 272) to be silver, lead, bismuth, zinc, and arsenic, with traces of copper and iron. Most of these metals are separated, we are told, from the residual metal—that is, the metallic mass left after the distillation of the mercury—in the dry way, and so lost; but a specimen of this residual metal which came into our hands was so rich in bismuth that we believe it would be found, at the present price of bismuth, to pay for the separation in the moist way.

But whatever Great Britain itself may lack in the way of gold mines would appear at first sight to be amply made up by the abundance of the metal in her dependencies. Nearly every one of our colonies has sent specimens. Here is gold from India, from most Australian provinces, from New Zealand, from British Columbia, from Canada, and Nova Scotia. We need not describe any of these. Our readers will be sure to look at them for themselves; and, besides, they have little scientific interest. We may mention, however, that the quantity received from Victoria since the pyramid under the Eastern dome was designed, amounts to 39 tons 7 cwt. 2 qrs. 7 lb. 3 oz.,—in value over five millions sterling.

In coal, too, our dependencies appear to be rich. The thoughtful visitor will remark with great interest the coals from India exhibited by Professor T. Oldham (17), who appends to his specimens analyses which show us that on an average these coals contain 60 per cent. of fixed carbon, 30 per cent. of volatile matter, and 10 of ash. As India becomes intersected by railroads, these coals will become of great value, and the Governor-General might take a lesson from President Lincoln, and try to convince the natives that the occupation nature obviously intended black people to follow is, beyond doubt, digging coal.

(To be continued.)

NOTICES OF PATENTS.

1726. *Obtaining Products from Alkaline Waste and Gas Lime Refuse.* Alfred Noble, Bristol. Dated July 6, 1861.

The object of this invention consists chiefly in a mode of preparing hyposulphite of soda from alkali waste, whereby a certain quantity of sulphur is at the same time economised. The process is carried out by exposing the alkali waste as usual for a few days to the oxidising influence of the air. The soluble portion is then extracted from the heap of refuse by treatment with water, which solution is then brought into contact with aqueous sulphurous acid, or the same substance in the state of gas. By this admixture sulphur is precipitated in a marketable form, and the solution now contains the hyposulphite of lime, which may itself be recovered in a solid state by evaporation, or preferably converted into the hyposulphite of soda by the action of carbonate of soda. Or, lastly, the aqueous solution may be mixed with hydrochloric acid, in order to furnish sulphur and sulphurous acid. Similar products may be obtained in like manner from the exhausted material taken from the lime purifiers of gas-works.

1732. *An Improved Process for the Manufacture of Fluosilicates and Silicates of Lead and Baryta, and for the Application of the same to Various Purposes in the Arts and Manufactures.* T. Cobley, Meerholz, Germany. Dated July 8, 1861.

The patentee prepares the compounds named in the heading by the action of hydrofluosilicic acid upon salts of lead or baryta; and claims the use of these substances, either separately or conjointly, as materials for the manufacture of glass and porcelain, and for the purposes of a glaze and pigment. The employment of minerals by admixture of which the before-named constituents would be brought into association, is equally included in the patent claim.

1734. *An Improved Process for the Treatment of Silicates of Metallic and Non-Metallic Bases, and other Siliceous Compounds, as Slags, Scoriæ, and such like, in order to recover the said Bases, and also in the Production of Fluosilicic and Silicic Acids.* T. Cobley, Meerholz, Germany. Dated July 9, 1861.

This patent claim refers to several well-known chemical reactions exerted between fluorine, silica, and their compounds; and the application of these to manufacturing purposes.

The patentee employs, firstly, the power of hydrofluoric acid to remove silica from its several combinations with bases, whereby, as the result of this action, the bases themselves are liberated, or converted into more available and soluble compounds. The gaseous products are,

secondly, employed in the simultaneous preparation of fluosilicic acid and finely divided silica.

1772. *Improvements in the Manufacture of Metallic and Earthy Silicates, or Siliceous Compounds of the same, from the Metallic and Earthy Bases, or their Salts and Soluble Alkaline Silicates; the Formation and Application of the same.* T. Cobley, Meerholz, Germany. Dated July 15, 1861.

The insoluble silicates, as those of lead, copper, zinc, baryta, &c., are directed to be prepared by double decomposition between the salts of these metals respectively, and a soluble alkaline silicate.

So far as regards the mode of production there is little novelty in this recommendation, but it is sought to apply the metallic compounds so precipitated for the purposes of glaze or enamel among other applications.

1773. *An Improved Process for Preserving and Indurating Timber, Wood, and other Vegetable Matters, and for Rendering them Uninflammable.* T. Cobley, Meerholz, Germany. Dated July 15, 1861.

In order to impregnate wood and other vegetable matters as a means of enabling them to withstand the action of heat and flame, the pores of the material are, in the first place, filled with a strong solution of baryta, potash, or other base, which forms with hydrofluosilicic acid a difficultly soluble compound. These liquids, or either of them, being forced into the structure of the wood by powerful hydraulic pressure, or other suitable means, the process is repeated with the application, in the second instance, of hydrofluosilicic acid. These two liquids are injected alternately until the pores of the wood refuse to absorb any longer, and are filled with the precipitated silicofluoride.

Grave objections may be urged against the employment of caustic alkalies for the purpose here specified, inasmuch as they induce a powerful contraction wherever the structure of the wood is subjected to their influence. This effect may be partially neutralised, but is not likely to be altogether overcome by the subsequent application of the acid.

1776. *An Improved Process for the Production or Manufacture of the Fluosilicates of Tin, Zinc, and Baryta, and their Application as Pigments for Glazing, Enamelling, and in the Manufacture of Glass.* T. Cobley, Meerholz, Germany. Dated July 15, 1861.

The patentee prepares the silicofluorides of tin and zinc, either by the direct action of hydrofluosilicic acid upon the metallic oxides, or by the addition of the acid to any of the soluble salts of these metals, whereby the compounds in question are precipitated; or, if the native silicate of zinc can be obtained free from iron, it is proposed to treat it simply with hydrofluoric acid to prepare the compound. In the case of baryta it is recommended to employ the mode of preparation described in a former patent (No. 1732); but another method of obtaining it is likewise claimed, which consists in treating the silicate of baryta with hydrofluoric acid. The compounds formed by precipitation are collected on a filter, washed and dried in the ordinary manner. The applications to which these products are suitable may be enumerated as follows:—The tin compound employed alone, or in conjunction with lead as a pigment, glaze, or enamel in the manufacture of porcelain; the chief use of the zinc salt is to serve as a substitute for lead in glass-making, also it can be employed as a glaze by fusion alone, or with baryta. And, lastly, the baryta compound itself is applicable to either of the purposes for which the two former are employed.

Grants of Provisional Protection for Six Months.

1090. Thomas Wood Gray, Fenchurch Street, London, "Improvements in the manufacture of explosive compounds."—A communication from Julian John Revy, Vienna.—Petition recorded April 15, 1862.

1184. Alfred Hodgkinson, Glenville Bleach Works, Belfast, Antrim, Ireland, "A mixture or composition to be used in the process of boiling, preparing, or bleaching vegetable substances, whether they are in the manufactured or unmanufactured state, which mixture may also be used in the manufacture of soap."—Petition recorded April 23, 1862.

2097. William Clark, Chancery Lane, London, "Improvements in the manufacture of manure."—A communication from Alfred François Mosselman, Boulevart St. Martin, Paris.

2101. James Dickson, Tollington Road, Holloway, London, "Improvements in treating copper ores and solutions of copper to obtain copper therefrom."

2107. William Henry Perkin, Seymour Villa, Sudbury, Middlesex, "Improvements in printing and dyeing when aniline and analogous coal-tar dyes are employed, also in preparing colouring matters."—A communication from Alexandre Schultz, Rue St. Fiacre, Paris.—Petitions recorded July 24, 1862.

2123. William Clark, Chancery Lane, London, "Improvements in obtaining or extracting silver from ores and other bodies, and in apparatus for the same."—A communication from Messrs. Charles Edward Auguste Vattier and Alfred Joseph Gustave Becourt, Boulevart St. Martin, Paris.

2130. William Spence, Chancery Lane, London, "Improvements in the preparation of a red colouring mattter."—A communication from Nicholas Philibert Guinon, Jean Aimé Marnas, and François Bonnet, Lyons, France.

2132. William Spence, Chancery Lane, London, "Improvements in the preparation of a blue colouring matter."—A communication from Nicholas Philibert, Guinon, Jean Aimé Marnas, and François Bonnet, Lyons, France.

2155. Michael Henry, Fleet Street, London, "Improvements in obtaining fibrous materials and paper pulp, in treating, cleansing, and scouring fibrous materials and fabrics manufactured thereof, in producing soap for the said operations, and in obtaining products from liquors used therein."—A communication from Jean Baptiste Vasseur and Victorien Joseph Janssens, Boulevart St. Martin, Paris.—Petitions recorded July 29, 1862.

2187. Thomas George Webb, Manchester, "Improvements in the manufacture of flint glass."—Petitions recorded August 1, 1862.

2199. William Clark, Chancery Lane, London, "Improvements in the purification of water, and in apparatus employed therein."—A communication from Maurice Laschi, Boulevart St. Martin, Paris.

2201. John Richard Nicholl, Streatham, Surrey, "Improved means of, and apparatus for, utilising and disposing of the sewage of towns and villages."—Petitions recorded August 5, 1862.

2234. Alexis Jean Moreau and Adolphe Ernest Ragon, Bernard Street, Russell Square, London, "Improvements in the manufacture of gas and coke."—Petitions recorded August 9, 1862.

2254. James Dickson, Tollington Road, Holloway, London, "Improvements in treating ores and solutions of lead to obtain lead therefrom."

2266. James Dickson, Tollington Road, Holloway, London, "Improvements in obtaining sodium from certain sources of that metal."

2272. Joseph Peters, Wouldham Hall, Rochester, Kent, "An improved hydraulic cement."

2294. William Bird Herapath, Old Market Street, Bristol, "Improvements in decolorising solutions of sugar, and also vegetable juices containing sugar."

2296. William Bird Herapath, Old Market Street, Bristol, "Improvements in treating crystallisable sugar to render it more suitable for fermentation and conversion

into alcohol and vinegar."—Petitions recorded August 14, 1862.

Notices to Proceed.

1090. Thomas Wood Gray, Fenchurch Street, London, "Improvements in the manufacture of explosive compounds."—A communication from Julian John Revy, Vienna.—Petitions recorded April 15, 1862.

1184. Alfred Hodgkinson, Glenville Bleach Works, Belfast, Antrim, Ireland, "A mixture of composition to be used in the process of boiling, preparing, or bleaching vegetable substances, whether they are in the manufactured or unmanufactured state, which mixture may also be used in the manufacture of soap."

2097. William Clark, Chancery Lane, London, "Improvements in the manufacture of manure."—A communication from Alfred François Mosselman, Boulevart St. Martin, Paris.—Petitions recorded July 23, 1862.

CORRESPONDENCE.

The Jury Award for Thallium.

To the Editor of the CHEMICAL NEWS.

SIR,—I should like to add one remark to the observations of "Spectroscope" and "An English Chemist" in your last Number.

M. Lamy, I hear, did not deposit his specimen of thallium in the Exhibition till the Jurors had concluded their tour of inspection. If this be so, the award of a medal to the French Chemist was irregular in the extreme.

Again, it has been stated that the Jurors' duty was not to recognise the scientific merit of your discovery, but to show their appreciation of the *bigger* specimen. But surely, taking this low ground, you exhibited, in its various salts, an actually larger amount of the new metal than did M. Lamy; not to mention the completer view of the whole discovery which you offered by the exhibition, not only of some minerals containing thallium, but of a clear drawing of its singularly simple spectrum.

I am, &c. JE VEUX DE BONNE GUERRE.

Chemical Notices from Foreign Sources.

Purification of Mercury.—We read in the "Proceedings of the Société de Pharmacie" (*Journal de Pharm. et de Chim.*, t. xli. p. 512) a plan of M. Barruel, who, when distilling mercury, places above it a layer of sand, by which means he arrests any of the metals that would pass over mechanically with the mercury vapour. M. Roussin suggested that the sand might be advantageously replaced by iron-turnings.

Useful Alloys.—Lenssen gives (*Journ. für prakt. Chemie*, bd. lxxxv. s. 98) the composition of an alloy which is used in some calico printworks at Mülhausen. It consisted of bismuth 10·15, tin 57·23, lead 31·15. The pattern is first cut in wood as a matrix, and is then impressed on the alloy. Clemens Winckler says (*Deutsche Industrie Zeitung*, 1862, No. 12) that a good alloy to replace brass for taps is made by melting together two parts copper, one part nickel, and one part tin. The product is slightly ductile, in colour resembles steel, and is very hard. It takes a beautiful polish, and is not acted on either by air or sulphuretted hydrogen. This alloy gives also a fine tone when struck, and may be used for bell metal.

Iodide of Nitrogen. — Stahlschmidt publishes (*Poggendorf's Annalen*, bd. cxv. s. 653) a preliminary notice of some new compounds which he has discovered. When iodide of nitrogen is mixed with iodide of methyl, a brown coloured fluid is found after a time, from which a pulverulent body separates. On longer standing, crystals of the same body are formed. These crystals dissolve with difficulty in boiling alcohol, and from this solution yellow spear-shaped plates crystallise out. The original liquor on evaporation yields more of this yellow substance; and at last green crystals, which possess considerable brilliancy, separate.

II. ORGANIC CHEMISTRY.

Action of Permanganate of Potash on Iodide of Potassium.—Weltzien has found (*Annal. der Chem. und Pharm.*, bd. cxx. s. 349) that permanganate of potash transforms iodide of potassium into iodate of potash; forming at the same time caustic potash and peroxide of manganese, exactly according to the equation $KI + KMn_2O_4 3H_2O = KIO_3 + 2KHO + 2\,(Mn_2O_2 + H_2O)$.

Transformation of Nitrobenzole into Benzole and Ammonia. — Scheurer-Kestner has observed (*Bulletin de la Société Chimique de Paris*, No. 3, 1862, p. 43) that by the action of acetate of iron on nitrobenzole, benzole and ammonia are formed. He noticed that aniline which contained benzole invariably contained ammonia also, and that the more intense the action of the acetate on the nitrobenzole, the larger the amount of those bodies formed. By employing four times the quantity recommended by M. Bechamp he found that the nitrobenzole was changed almost entirely into benzole and ammonia. The action is very violent, and the operation must be conducted in a strong iron vessel.

Sulphide of Ethylene.—Mr. Crafts, in a paper to the Chemical Society of Paris (*Bulletin de la Société, &c.*, No. 3, 1862, p. 39), describes the formation of two sulphides of ethylene by the action of bromide of ethylene on an alcoholic solution of monosulphide of potassium. The white mass resulting from the action is at first slightly soluble in water, but after drying it becomes insoluble. Analysis showed that it was a mixture of the monosulphide of ethylene with a higher sulphide of the same radical. Ether or boiling alcohol first dissolved a small quantity of the sulphide C_2H_4S, which crystallised on evaporation. When heated with ether in a sealed tube, a much larger quantity of the same crystals was obtained, and also an orange coloured oil more soluble in ether, which the author supposes to be $C_2H_4S_2$. The crystals, the oil, and a residue of carbon are obtained when the white mass is submitted to distillation. The first begin to distil at 70°, and the orange coloured oil passes towards 220°; beyond this heat decomposition takes place, sulphuretted hydrogen is evolved, and carbon is deposited. Mr. Crafts notices some resemblances between the crystallised sulphide of ethylene and a body having the same empirical formula which Weidenbusch obtained by substituting sulphur for the oxygen contained in aldehyde; but he adds that there is a difference in the crystalline form of the two compounds, as well as some difference in their properties.

MISCELLANEOUS.

Rice Glass from Japan.—In our last Number, p. 120, we gave what we believe is the true composition of this curious article. The following paragraph, which is from the *Engineer*, embodies the general opinions on the subject:—"At the corner of the stall where the carpenter's tools are displayed, there is an article exhibited which has puzzled everybody who has seen it. It is a small screen of what appears to be slender glass rods, woven together with string. Glass, however, in the strict acceptation of the word it is not. So perfect is the transparency, so hard and vitreous the appearance of the surface, that it does indeed require faith to believe it is what it is represented to be—boiled rice! It was only after I had succeeded in scratching with a pen-knife the end of one of the rods that I was able to give any credence to the statement made by the attendant at the stall. According to his account, the rice is boiled until it becomes gelatinous. The starchy portion is then washed out, and the boiling continued until it becomes a clear transparent jelly, which,

on drying, assumes all the characteristics of malleable glass, and can be drawn and twisted into any form which may be desired. He told me that as silica or flint forms a considerable constituent of rice, as indeed it does more or less of all cereals, that the rice glass was a combination of silica with vegetable albumen. However this may be, it appears to be something altogether novel in the form in which it is displayed. I am not aware of any similar substance, at once hard, transparent, and *insoluble*, which can be compared with it. I remember to have seen a peculiar substance which the Chinese manufacture from boiled rice, but that was an opaque material, similar to what we make bread seals of, and which is unquestionably capable of being softened in water. Schönbein's glass paper, formed by a process analogous to that by which cotton fibre is converted into collodion, seems the nearest approximation to the rice glass that I have ever met with. There cannot be a doubt that this material, if it can be at all cheaply prepared, may be extensively employed for decorative and other purposes."

New Gun Metal.—The cannons newly cast in Austria for the marine service, and from which so much is expected, are formed from a new alloy called Aich metal, from the name of the inventor. It is composed of copper, 600 parts; zinc, 382; iron, 18. Its tenacity is said to be excessive; it is easily forged and bored; when cold it may be bent considerably without breaking; its resistance is far greater than that of iron of the best quality. This announcement makes us earnestly wish to learn the fate of the cannon of aluminium bronze, which M. Christophe cast at his own expense, and which was so severely tried at Vincennes.—*Cosmos.*

Phosphorescent Pork.—M. Hankel, in the *Annalen der Physik*, gives an account of the phenomenon of phosphorescence appearing on pork. The phosphorescence was silvery white, and enlightened the neighbouring objects. It was superficial; for, on cutting the flesh with a knife, the under part was obscured till after a certain time, when doubtless the oxygen of the air had had time to act. The phosphorescent matter was of an unctious character, and M. Hankel could not perceive in it any traces of organised beings. The light was annihilated by the application of ether, alcohol, a solution of caustic potash, cold, hot water, and a temperature of 104° F.; but in the last two cases the light reappeared when the flesh was restored to the ordinary temperature. The light also disappeared when placed in a vacuum, or in an atmosphere of carbonic acid; but returned when a little oxygen was permitted to enter. Sulphuric acid annihilated it for ever. Ozonised oxygen does not sensibly affect this phosphorescence. Fatty oils lessen its duration (this is the case also with distilled water); but none of these liquids become phosphorescent by contact with this animal matter. This phenomenon has been previously observed in sea-fish, at the time when they were on the verge of putrefaction, and has been called the "glow-worm fire." The same appearance is sometimes offered by rotting wood. It is not certain that in any of these cases the appearance is due to the oxidation of phosphorus. It would be important to learn whether the pork described by M. Henkel is poisonous when "phosphorescent."—*British Medical Journal.*

The Official Illustrated Catalogue.—To assist our studies of Class II. we naturally turned to the pages of the Official *Descriptive* Illustrated Catalogue of that department, or, rather, what we expected to find the Official *Descriptive* Catalogue, bearing in mind the valuable production of 1851. We were doomed to disappointment; for, upon turning over page after page of this official abortion, we found that its more fitting title would have been "The Royal Commissioners' Exhibition Advertiser," for as neither matter nor illustration were admitted without being handsomely paid for by exhibitors desiring a description of their goods, the result may be anticipated by any person possessed of common sense who will give five minutes' thought to the matter.* If it be desirable to produce an official description of the articles contributed to an International Exhibition—and, for obvious reasons, there is no question but that such a Catalogue ought to form part of the programme of every such Exhibition—making a proviso that the exhibitors themselves must pay the cost of its production, is a very certain way of attaining that official goal,—"How not to do it!" How is it possible to secure, under such circumstances, the co-operation of a mixed class of men of many nations, who are exhibitors for varied motives? The majority, either from want of means or will, could not, or would not (as the result proves), send in descriptions of their goods, if it be a *sine quâ non* that they must pay at the rate of five guineas a page for insertion! For the Catalogue of 1851 every exhibitor was requested to send in a description of his goods, subject to the supervision and curtailment of competent editors, but free of charge (except in the case of illustrations). The result was a work that is full of matter, and that will be valuable to all time. The production of 1862 is little more than a reprint, in large type, on fine paper, of the shilling Catalogue. The descriptions of articles are generally imbued with the advertising element, and contrast very unfavourably with the style of matter in the Catalogue of 1851. Even if we turn to the illustrations, they are, in many instances, discreditable to the work, which, emanating under the auspices of a Royal Commission, might fairly be expected to attain to the highest standard of excellence. At page 40 we have a ridiculous cut of a blacking-brush and blacking-bottle, wielded by a pair of swarthy arms; at page 45 a charming group of "flaming fusee" boxes, supported on one side by a gentleman lighting his cigar with a fusee, and on the other by a man at the helm lighting his pipe with the same—a very fitting cut for the back page of *Bell's Life*, or even the advertisement pages proper of the Illustrated Catalogue; for it will be seen that the work is divided into advertising pages proper and improper. At pages 64, 71, and 79, we are favoured with artistic and unartistic designs of sauce and soda-water bottles—one group occupying the best part of a page. At page 99 there is a perfect eruption of brushes, "scrubbing," "deck clamp," "horse water," "horse body," down to "Scotch scrub," which last we take to be an invention of the celebrated and philanthropic Duke of Argyle of posting renown. At page 112 there is a fancy portrait of a civet cat that will enchant Dr. Edward Gray, of the British Museum, who is a Juror in the Educational Class, and who will doubtless be impressed with the progress of ideas on popular Zoology since 1851. At pages 97 and 101 much space is given (or rather paid for) to two large cuts of the Council Medal of 1851, the connexion of which with the Descriptive Catalogue of 1862, however, not being quite apparent. And, lastly, the best part of a page is given to a representation of the top of a tooth-powder pot, and "such small deer." We feel quite assured that if this (which should be an important record of a great gathering of the inventions of nations) had been confided to the care of such houses as Longman's or Murray's, either would at once have excised half the matter and most of the illustrations that have been "approved"† by a Royal Commission, in its feverish desire that "something should pay."—*The British Journal of Photography.*

* Some one experienced in publishing matters must have anticipated the failure of this advertising venture; for we find that the title of the production stands "Official Illustrated Catalogue," and not, as in 1851, "Official Descriptive and Illustrated Catalogue."

† "Exhibitors must provide their own woodcuts or engravin which, if approved by the Commissioners, will be inserted." *V* "Prospectus of Official Illustrated Catalogue."

THE CHEMICAL NEWS.

VOL. VI. No. 145.—September 13, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chemical Examination of Iron Samples, and of the Materials employed in their Manufacture, by* F. A. ABEL, *Esq., Chemist of the War Department.*

(*Continued from page* 125.)

Phosphorus.—For the estimation of phosphorus, 50 grains of the iron borings were acted upon with warm nitro-hydrochloric acid, in a flask with a long neck, and, after complete solution of the metal, the contents of the flask were transferred to a porcelain basin and evaporated to dryness; the residue was moistened with concentrated hydrochloric acid, and again evaporated, so as thoroughly to expel nitric acid. The residue then obtained was dissolved in hydrochloric acid, the solution diluted, filtered, nearly neutralised with carbonate of ammonia, and the iron in solution reduced to protoxide by the addition of sulphite of ammonia to the gently heated liquid, and the subsequent careful addition of dilute sulphuric acid to expel excess of sulphurous acid. Acetate of ammonia and a few drops of solution of sesquichloride of iron were then added, and the liquid boiled, when the phosphoric acid was precipitated as basic phosphate of sesquioxide of iron, with some basic acetate. The liquid was rapidly filtered, with as little exposure to the air as possible, the precipitate was slightly washed and dissolved in hydrochloric acid, the solution neutralised with carbonate of ammonia, and a mixture of ammonia and sulphide of ammonia added; it was then gently heated, to ensure the conversion of the phosphate into sulphide of iron. The latter was afterwards removed by filtration, washed with dilute sulphide of ammonium, and the phosphoric acid was precipitated from the solution in the usual manner as ammonio-phosphate of magnesia, and weighed as pyrophosphate of magnesia, from the amount of which the phosphorus was calculated.

Combined Carbon.—After numerous comparative trials of the several methods in common use for determining the total amount of carbon in cast iron, that which was ultimately adopted (after necessary experiments had fully established its accuracy) consisted in dissolving the metal in an acid solution of chloride of copper, collecting and washing the insoluble residue which remained after the complete action of this solvent, and submitting it, when dry, to combustion with oxide of copper in a current of oxygen, the source of heat employed being the gas combustion furnace. The total amount of carbon in the iron was then calculated from the weight of carbonic acid absorbed by solution of potassa in the usual manner. The carbon, existing in a state of combination with the iron, was represented by the excess which this process afforded over that of the direct estimation of the carbon as graphite, in the manner already described.

Minute Proportions of Foreign Metals.—About 400 or 500 grains of the iron were employed in the examination for metals precipitated by sulphuretted hydrogen, *e.g.*, lead, copper, arsenic, &c. The iron was dissolved in hydrochloric acid, and the solution, diluted and partly neutralised with carbonate of soda, was submitted to the action of sulphuretted hydrogen. After saturation with the gas, the liquid was allowed to stand at rest for several hours, and the small quantity of sediment which had subsided was examined for metals by the ordinary analytical processes.

II.—ANALYSIS OF THE IRON ORES.

The analytical processes employed for the separation of the various constituents occurring in iron ores were, in great measure, identical with those employed in the examination of metallic iron. Thus, the estimation of oxide of manganese was conducted in a precisely similar manner; and, with the exception that no process of reduction was required in the case of clay ironstones and other ores containing the iron already in a state of protoxide, the phosphoric acid was determined by the same process as that employed for the estimation of phosphorus in pig iron. The amount of metallic iron, and its condition of oxidation in the ore, were determined by Marguerritte's volumetrical method, with standard solution of permanganate of potassa; while the proportions of lime and magnesia, carbonic acid, water, hygroscopic and combined, insoluble residue, and the nature of this latter, were determined by following the analytical processes invariably employed in mineral analyses of this description.

Sulphur was estimated by fusion of the ore (or, in the case of clay ironstone, of the clay only) with a mixture of pure carbonate of soda and nitre; the sulphuric acid being precipitated by chloride of barium, from the acidified solution of the fused mass, and the sulphate of baryta collected, burnt, and weighed as usual. The hydrochloric acid solution of the ironstone was examined for sulphuric acid, but it was seldom that more than a trace of sulphur was detected in that form.

III.—ANALYSIS OF THE SAMPLES OF FLUXES.

These materials, consisting of limestone, burnt shale, &c., were analysed by a method precisely similar to that employed in the examination of the ores. In the tabulated statement showing the composition of the limestones, the amount of carbonate of lime is, in some few instances, represented by the difference, after the whole of the other constituents had been determined. In such cases the sum total of constituents is necessarily expressed by 100 exactly.

* Report of Experiments on British Irons, Ores, &c., for the Manufacture of Cast Iron Ordnance.

IV.—ANALYSIS OF THE SAMPLES OF FUEL.

Sulphur.—For the estimation of sulphur, 20 grains of the finely powdered coal or coke were fused in a platinum basin, with 500 grains of a mixture of four parts of pure chloride of sodium, two of nitrate of potassa, and one of carbonate of soda. The filtered aqueous solution of the fused mass was acidulated, precipitated by chloride of barium, and the sulphate of baryta collected and weighed.

Ash.—The ash left on burning a weighed portion of the coal or coke was also determined, and its composition ascertained by qualitative examination.

Results of the Chemical Examination of Iron, and Materials employed in its Production.

A special report has been drawn up on the results of the analytical examinations of each set of samples received from the various works.

To facilitate a comparison between the composition of the irons, ores, &c., tabulated statements have been prepared, of the following description :—

Table I. embraces the numerical results obtained in the examination of the samples of iron.

Table II. exhibits the per-centages of the most important constituents of the various ores; and,

Table III. includes, similarly, the principal results obtained in the examination of the fuels and fluxes.

The following are a few remarks which have suggested themselves upon an inspection of these tabulated results :—

The specimens of iron prepared from the ores of the Northern District and from the Forest of Dean are remarkably free from phosphorus. This is readily explained by the very high quality of these ores, which are almost perfectly free from phosphoric acid. The considerable per-centage of silicon contained in a great number of the specimens of iron alluded to is perhaps less easy of explanation. A reference to the composition of the specimen of Ulverston (Hæmatite) iron, given in the Appendix to this Report, which was smelted with charcoal, and only contains 0·59 per cent. of silicon, would appear, however, to indicate definitely that the high proportions of silicon must be ascribed to the employment of hot blast in the reduction of the iron at those works.

The products of the ores from South Staffordshire and South Wales which have been examined are, with two or three exceptions, of excellent chemical quality. Only three instances occur in these divisions of the series of iron samples (out of 26 samples from eight different works) in which the amount of silicon reaches 2 per cent. The samples from the Netherton and Old Hill Works (South Staffordshire), and the Blaenavon and Pontypool Works (South Wales), in the preparation of which cold blast is specified as having been employed, the silicon in only two instances (out of 13 varieties of iron) slightly exceeds in amount 1·15 per cent.

The proportions of phosphorus and sulphur in irons from the ores of these districts are also inconsiderable in the majority of the samples examined. In the case of three only (out of 26) does the amount of sulphur reach to 1-10th per cent., and the phosphorus amounts to less than 0·5 per cent. in 20 instances; of the other six, three contain less than 0·6 per cent.; one from the Old Hill Works contains 0·63 per cent.; and two samples from Brierly Hill Works contain 0·63 and 0·72 per cent. The ores employed at the latter works contain somewhat high per-centages of phosphoric acid, the effects of which on the composition of the iron produced are, therefore, clearly traced. The per-centages of phosphoric acid in the ores used at the Old Hill Works (particularly in the "Balls," Bilston) are also higher than those in most of the ores used at the remaining South Staffordshire works, and its influence on the quality of the product is, to some extent, shown by a reference to the composition of some of the irons from those works.

That the proportion of phosphorus in the iron is not always determined by the proportion of phosphoric acid existing in the ore employed, need, however, be scarcely pointed out. The fact may be exemplified by reference to some of the samples of iron from the works last alluded to, and to the iron from the Lays Works, near Dudley, in which the per-centage of phosphorus is small, while the phosphoric acid in the ore is comparatively high. The circumstance that the proportion of phosphorus in all the samples of iron from the Blaenavon Works is small, while several of the ores employed contain considerable quantities of phosphoric acid, is probably to be ascribed to the employment of cold blast in the reduction of the iron at those works.

The oolitic ores and the clay ironstones employed at the works in the North Midland and North Staffordshire districts, from which specimens were submitted, as also the ochrey brown ironstones employed at the Northamptonshire Works, contain proportions of phosphoric acid, which are more considerable than those existing in the greater number of the other ores examined. Thus, the ore employed at the South Bank Furnaces contains nearly 2 per cent. of phosphoric acid; that used at the Stockton Works contains upwards of 1·5 per cent., and very nearly the same amount exists in one of the ores at the Butterley Works, and in that employed at the Goldendale Works (North Staffordshire). The proportions of phosphorus in the various samples of iron from these sources exceed 1 per cent., excepting in one sample from the Butterley Works, in which, however, it amounts to 0·72 per cent.

The samples of iron produced from Northamptonshire ores also contain more than 1 per cent. of phosphorus the proportions of phosphoric acid in the ores are, however, not quite as high as those last alluded to, amounting to 0·84 and 1.03 per cent. The samples of iron from one of the works (the East End Iron Works) are, moreover, stated to have been produced with cold blast.

The North Staffordshire ore, used at the Goldendale Works, contains nearly 1·5 per cent. of phosphoric acid, and the proportion of phosphorus in the iron produced from it just exceeds 1 per cent.

A general inspection of the results obtained in the examination of the samples of ores and of the iron varieties produced from them, appears to justify the following conclusions, upon which metallurgic chemists are now tolerably well agreed :—

1. The proportion of silicon in iron is much less influenced by the constitution or quality of the ores employed than by the conditions of smelting. A reference to the composition of the Northamptonshire ores and iron samples (particularly those from the Heyford Works), indicates that under certain circumstances, among which may probably be included a deficiency in alumina, in the ore or the flux employed, an ore containing much silica is very liable to furnish a highly siliceous iron.

2. The proportion of sulphur existing even in light grey pig iron is never so considerable as to exert an appreciable influence on the properties of the metal; and none of the descriptions of British ores which have been examined in connexion with this Report contain an amount of sulphur compounds sufficient to exert any

prejudicial influence on the quality of iron produced from them.

3. The proportion of phosphorus in iron is, in great measure, determined by the per-centage of phosphoric acid in the ore employed, while, at the same time, it is probably to some extent regulated by the temperature at which the reduction is effected (*i.e.*, by the employment of hot or cold blast).

The various ores examined, if classed according to the per-centage of phosphorus in the iron reduced from them, would stand in the following order:—

No. 1. Northern District and Forest of Dean ores, used by the Whitehaven, Weardale, and Parkend Works.

No. 2. South Staffordshire ores, used at the Netherton, Parkhead, Old Hill, Lays, and Level Works; South Wales ores, used at the Ystalyfera Works; South Wales ores, smelted with cold blast at the Blaenavon and Pontypool Works.

No. 3. North Midland ores, used at the West Hallam Works.

No. 4. Northamptonshire ores, used at the East End and Heyford Works; North Staffordshire ore, used at the Goldendale Works; North Midland ores, used at the Butterley Works.

No. 5. Cleveland ores, used at the South Bank and Stockton Works.

It will scarcely be out of place to conclude these few remarks on the results of the analytical examinations with some notice of the very considerable difference observed in the structure of many of the samples of iron analysed, and particularly in the physical condition of the so-called graphite, as exhibited by fresh fractures of the metal. In some instances a grey iron containing a per-centage of graphite similar to, or even higher than, that in a second sample exhibited a dense compact structure, while that of the other sample was open grained, and showed the existence of the graphite in large and distinct scales. These modifications in the structure of pig iron are so well known that they are only alluded to because it is to them that must undoubtedly be ascribed, in many instances, the apparent discrepancies (which may be noticed by a comparison of the results included in this Report) between the chemical quality of a sample of iron and the results which it has furnished when submitted to mechanical tests. It is self-evident that a sample of grey iron, compact and uniform in structure, may resist the application, for example, of a much more considerable tensile strain than one which is of higher chemical quality (*e.g.*, containing less silicon or phosphorus), but of which the structure is comparatively open and irregular. There is little doubt, also, from the results of numerous experiments which have been made in this direction, that the effect of adding considerably to the strength of some kinds of cast iron by repeatedly re-melting them is, within certain limits, due to no important chemical change effected in the iron, but to the gradual production of a more thoroughly uniform mass, in which the graphitic carbon has gradually undergone a material change in its state of aggregation.

On Cadmium, by B. Wood, *M.D.*

The properties of cadmium appear to have been less clearly determined by chemists and metallurgists than those of most other metals. Discrepancies exist in regard to it; while some of its most remarkable, if not most useful, properties are not at all noticed, at least by the generality of authors, even when explicit and elaborate as to similar properties possessed by other metals. Our ordinary works on chemistry treat of the metal very briefly as of little importance: one of the latest says, it "has *no* practical value in the arts;" but if duly investigated it will be found, I think, to possess qualities highly useful to the arts, as well as interesting to science.

The melting point of cadmium is variously stated by authors. Some place it indefinitely, "below a red heat." Overman, in his "Treatise on Metallurgy," marks it at 550° F., and indicates 600° as the temperature at which the metal volatilises. Brande ("Dict. Science and Art") says, "it fuses and volatilises at a temperature a little below that at which tin melts." Webster ("Manual of Chemistry") states that "it melts and volatilises by a heat not much greater than that required to vaporise mercury." Most of our chemical text-books put its melting point at 442° (from Stromeyer); while the New American Cyclopædia, now in course of publication, places it, on the authority of Daniell, at 360° F.

It would be interesting to determine this accurately; but the heat being too high for measurement by the mercurial thermometer, and having no other, I have only been able to judge approximately by comparative tests. Melted under similar conditions with other metals, I find the metal requires for its fusion nearly the same heat as lead. It is somewhat later in melting, but, on the other hand, it appears to congeal a little the sooner, which may be due to a difference in the conducting power of the two metals. I should, therefore, place its melting point, in round numbers, at 600° F., that of lead being placed by different authors at 594°, 600°, and 612°. It volatilises at a somewhat higher temperature, giving off orange-coloured, suffocating fumes, which, when inhaled too freely, leave a disagreeable, sweetish, styptic sensation upon the lips, and an intolerable and persistent brassy taste in the mouth and fauces, with constriction of the throat, heaviness in the head, and nausea.

Of the general properties of cadmium as an ingredient in alloys, Overman, who I believe is a high authority in metallurgy, and who, although too broad in some of his conclusions, is more rigidly exact in respect to the individual instances adduced than others that I have had the opportunity of examining, says:—

"Cadmium is very soft and malleable, and still all its alloys are brittle. Its combinations are not distinguished for fluidity." Again:—"The combinations of platinum, copper, and other metals with cadmium are brittle and hard." The cause of this he ascribes to "its volatile nature and want of affinity," which, recurring to the subject, he accounts for thus:—

"When it is melted with any other metal there is a tendency on its part to evaporate. The slight affinity of cadmium for other metals causes a separation of its atoms from those of the other metal, and no intimate union can be formed. If, therefore, the alloy cools, there are spaces between the crystals which have been occupied by the expanded atoms of cadmium, and in cooling these are filled again; this causes brittleness." ("Treatise on Metallurgy," p. 465.)

All this is strictly true of some of its combinations, such as the particular instances which he cites, although by no means of "all," as will presently be seen.

Other authors, although less explicit, are to a like import, ascribing a similar general character to the metal, with examples in illustration, and without instancing any exceptions.

In a copy of an article on Alloys of Cadmium from Berthier's "Traité des Essais," tome ii. p. 530, furnished me by the Patent Office as authority on the subject, I

find it stated in general terms that "most of the alloys of cadmium are brittle." The individual alloys cited are particularly characterised as brittle, and no mention is made of others. The combination with mercury is thus described:—"Cadmium unites with great facility with mercury, even when cold. The amalgam is of a silver white, and texture granular and crystalline. It can be obtained in octohedrons. It is hard and very fragile. Its density is greater than that of mercury. It fuses at 75° C. It contains 0·217 of cadmium."

Combined in these proportions, the compound will, indeed, be comparatively fragile; but one might be led to infer from this description that the metals combine in no other proportions. I have seen this particular form of amalgam cited by other authors when speaking of the combination of cadmium with mercury, but without any allusion to other compounds of these metals, although they unite with facility in other proportions, forming amalgams particularly noteworthy as contrasted with those of other metals.

While it has been assumed as a general rule, as above quoted, that the combinations of cadmium are not distinguished for fluidity, I have not found its fluidifying properties in respect to certain metals and alloys noticed in any work to which I have had access. Some of its alloys, indeed, are not remarkable for fusibility, but rather for the reverse; such are its alloys with silver, antimony, and mercury, their melting point being but little lower, or even higher, than that of the mean of their constituents. But others are much more fusible than the mean, as its alloys with lead, tin, copper, bismuth, zinc. In certain instances it manifests this property in so eminent a degree that it is singular it should not, if known, have been explicitly stated in all professed descriptions of the metal. Bismuth holds a high rank among metals for its property of promoting fusibility in alloys, as is particularly remarked in all chemical text-books, and wherever the metal is treated of, its alloys with lead and tin being specially noted as extraordinary instances. But in some combinations cadmium displays this property more decidedly than even bismuth. The alloy composed of from one to two parts of cadmium, two parts of lead, and four parts of tin, is more fusible than the corresponding alloy of two parts (or less) of bismuth, two of lead, and four of tin. In smaller proportions its superiority is still more marked, requiring much less to produce the same effect, while it does not impair the tenacity and malleability of the alloys, but confers hardness and general strength.

As to the brittleness which cadmium is said to communicate when combined with any other metals, the facts are, some of its alloys, even with malleable metals, are "brittle." But others are highly tenacious and malleable. Its alloys with gold, platinum, and copper afford instances of the former. Its combinations with lead, tin, and, to a certain extent, with silver and mercury, are examples of the latter. An alloy of two parts silver and one of cadmium is perfectly malleable, and very hard and strong. With equal parts of each it is also malleable, but possesses less tenacity; but when mixed in the proportions of two parts of cadmium and one part of silver, it is brittle. Equal parts of cadmium and mercury form a tough and highly malleable composition; in the proportions of two parts of the latter to one of the former, the amalgam is nearly equal in malleability, but possesses less strength. These mixtures are remarkable in view of the fact that most amalgams are exceedingly frail and brittle. A mixture of two or three parts of tin with one part of mercury is so fragile as almost to drop to pieces in handling. The amalgams with lead, bismuth, &c., are similar.

The fusibility of the compounds of cadmium and mercury is nearly that of the mean of their constituents, as, indeed, appears to be the case with other amalgams. I do not perceive that mercury acts as a fluidifying agent in alloys. It does not strictly promote fusibility, but serves merely to communicate of its own fluidity to the compounds in nearly the ratio in which it is employed; it does not, like cadmium, bismuth, &c, confer any new property in this respect. Being fluid at 39° below the zero of Fahrenheit's scale, it will of course, if it only retains its own property, reduce the melting point of the compounds into which it enters as an ingredient below that of the metals with which it is united.

Most of the mixtures of mercury with other metals, although it may form certain definite compounds with them, indicate combination by simple solution and mechanical admixture rather than by chemical affinity. With cadmium, however, it exhibits a marked affinity for forming amalgams, or, as they might be appropriately designated, alloys which possess distinctive characters, indicating a true chemical combination.

But I leave these speculations to professed chemists, hoping the points herein referred to may serve to incite attention to a subject which, I think, will repay investigation.—*Journ. Franklin Institute.*

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by Frank H. Storer *and* Charles W. Eliot.*

(*Continued from page 122.*)

In the analyses given, the precipitates had been somewhat washed before any analysis was made; it remained to analyse the substance precipitated with so much of the adhering filtrate as could not be removed by pressure between folds of filter-paper without washing. One precipitate (analysis *g*) was prepared by mixing a solution of one equivalent of chrome alum with eight equivalents of chromate of potash in solution, and a second by mixing a solution of one equivalent of chrome alum with sixteen equivalents of chromate of potash in solution (analysis *h*). In both cases the solutions used were concentrated, and the precipitates air-dried. The method of analysis which we had heretofore employed was open to one objection,—a trace of chromic oxide was liable to be dissolved in the excess of ammonia, to be again separated when the filtrate and wash-waters from the chromic oxide precipitate were concentrated by evaporation, and the process would obviously be altogether inadmissible in any case where the sulphates of the mother-liquor had not been removed by washing before submitting the precipitate to analysis, since sulphate of lead would be formed, and vitiate the determination of the chromic acid. We therefore resorted to Rose's method of separating chromic oxide from chromic acid, by means of the nitrate of the suboxide of mercury.† The solution of the substance to be analysed in dilute nitric acid was nearly neutralised with carbonate of potash, and when the carbonic acid had been allowed sufficient time to escape, nitrate of the suboxide of mercury was added, the precipitate filtered off, washed, strongly ignited, and the chromic acid calculated from the pure chromic oxide

* Read before the American Academy of Arts and Sciences.

† "Handbuch der Analytischen Chemie" (Braunschweig, 1851), ii. 379.

which remained. To the filtrate from this first precipitate ammonia in excess was added, and the washed precipitate, strongly ignited, was the chromic oxide contained in the original substance.

Analyses.

	g.	*h.*
Cr_2O_3	33·06 per cent.	33·54 per cent.
CrO_3	32·03 ,,	30·53 ,,
HO (by diff.)	34·91 ,,	35·93 ,,

It is quite evident from these analyses that the precipitate caused by mixing chromate of potash with a neutral chrome salt cannot contain more than one equivalent of chromic acid in combination with its chromic oxide, since in the above determinations the chromic acid is nearer one equivalent than two with reference to the chromic oxide found, in spite of the fact that the considerable amount of chromic acid which, combined with potash, has adhered mechanically to the precipitate, is thrown down by the nitrate of the suboxide of mercury, together with the chromic acid which was originally united to the chromic oxide. But the fact that the substance under examination cannot be purified by washing without altering its constitution, renders it impossible to ascertain the exact composition of the body by the methods of analysis heretofore used, or by any similar methods; for this purpose the process used by Vogel‡ in analysing the same substance, obtained by him from a different source and miscalled CrO_2, is admirably adapted. The precipitate examined by this method was not washed at all, but was simply dried by pressure between folds of filter-paper and exposure to the air. A weighed portion was placed in the bulb of a reduction-tube, with which a weighed chloride of calcium tube was connected; a current of dry air was then drawn through the apparatus, and the reduction-tube was cautiously heated till all the water of the precipitate had been absorbed by the weighed chloride of calcium tube, the heat finally rising to dull redness. The salts with which the precipitate under examination was contaminated were sulphate of potash, bichromate of potash, and a little chromate of potash, and since the solutions from which the precipitate was prepared were concentrated, it was to be expected that a considerable quantity of these salts would adhere to the precipitate; but since all these salts are fixed at a low red heat, they were not altered by the heat to which the precipitate was exposed. The rest of the precipitate must have lost by the ignition all its water and all the oxygen over and above that necessary to the constitution of chromic oxide. By subtracting the weight of the water collected from the total loss by ignition, the weight of the oxygen expelled is obtained. The ignited residue was then washed out of the bulb of the reduction-tube, digested in hot water, thrown upon a filter, and washed with hot water till only pure chromic oxide remained; lastly, this oxide was ignited and weighed. By subtracting the weight of the chromic oxide from the weight of the whole ignited residue, the weight of the soluble salts which adhered mechanically to the precipitate was obtained. The following are the figures of an analysis by this method:—

	Grammes.
Weight of reduction-tube + precipitate	10·3848
Weight of reduction-tube	9·6136
Weight of precipitate	0·7712
Weight of reduction-tube after ignition	10·2673
Loss by ignition	0·1175
Weight of residue	0·6537
Weight of CaCl tube after ignition	17·4196
Weight of CaCl tube before ignition	17·3204
Weight of water	0·0992
Weight of oxygen = ·1175 — ·0992 =	0·0183
Weight of crucible + Cr_2O_3	13·1275
Weight of crucible + filter-ash	12·9601
Weight of Cr_2O_3	0·1674
Weight of soluble salts = ·6537 — ·1674 =	0·4863

In the compound whose formula is $Cr_2O_3CrO_3$, the ratio of the number of atoms of oxygen to the number of atoms of chromium is that of 2 : 1. By adding another equivalent of oxygen to the chromic oxide found, we shall make the ratio of the atoms of oxygen to the atoms of chromium that of the compound $Cr_2O_3CrO_3$. Hence the proportion.

(Equiv. Cr_2O_3) (Equiv. O) = (Cr_2O_3 found) (1 equiv. O)

76·48 : 8 = 0·1674 : x = 0·0175

If the original precipitate was the compound whose formula is $Cr_2O_3CrO_3$, the loss of oxygen by ignition would have been 0·0175 gramme; the actual loss was 0·0183 gramme, being within 0·0008 gramme of the theoretical amount. A loss of eight-tenths of a milligramme in the water determination would of course account for this very small excess of oxygen.

A second analysis by this method of a precipitate containing a smaller proportion of soluble salts corroborated the first determination in every respect, and left no doubt that the true composition of the precipitate produced in the aqueous solution of a neutral salt of chromic oxide by the solution of chromate of potash is represented by the formula $Cr_2O_3CrO_3$.

2. Schweitzer§ observed that, when nitric oxide is passed through a moderately dilute solution of bichromate of potash, a brown precipitate separates after some time, especially if the liquid be slightly warmed. He did not analyse the substance, but remarks that it presents all the appearance of the brown oxide of chromium (so called). We prepared this compound by passing a stream of nitric oxide through a very dilute solution of bichromate of potash (a strong solution will not give the reaction so readily, if, indeed, at all) for three hours; in a few minutes the liquid became dark-coloured and ceased to be transparent, but after standing twenty-four hours, during four of which it had been gently heated, there was still no apparent deposit; it was again warmed, and after sixteen hours more a slimy red-brown deposit was found at the bottom of the vessel. During forty-eight hours longer this deposit was allowed to accumulate, when the supernatant liquid was decanted and the precipitate thrown upon a filter. The decanted fluid continued to deposit very slowly this red-brown matter for days and weeks; indeed, in this, and several similar experiments, we have found no limit of time to the continuous, though very gradual, accumulation of this deposit. The slimy precipitate which had been filtered off was washed with hot water for twelve hours, the water at first coming through of a dark red colour, but growing gradually paler till it retained only a feeble yellow. The washing was continued for a week with cold water, and more than nine litres of water passed through the small precipitate. Whenever the colour of the wash-water became so pale as to be hardly perceptible except with a considerable thickness of liquid, it was only necessary to transfer the precipitate to a mortar, rub it with water, and throw it upon a fresh

‡ *Journ. prak. Chemie*, lxxvii. 484 (1859).

§ *Journ. prak. Chemie*, xxxix. 269 (1846).

filter, in order greatly to intensify the yellow colour of the filtrate. Believing that the chromic acid which coloured the wash-water was derived from the decomposition of the precipitate, we stopped the washing on the eighth day, dried the precipitate at 50° to 55°, and analysed it by the first method described above. The colour of the solution of the substance in dilute nitric acid was red-brown, and of the precipitate produced by ammonia, dirty green, which washing changed to the usual colour of chromic oxide. The result of the analysis was,—

Cr_2O_3	=53·31 per cent.
CrO_3	=18·64 ,,
HO (by difference)	=28·05 ,,

In regard to the ratio of the chromic oxide to the chromic acid, this result is very much like that of the first analysis given (page 121), and leads to the same conclusions,—viz., that the original precipitate is a compound of chromic oxide and chromic acid, from which prolonged washing abstracts chromic acid to an indefinite extent. We next prepared a new precipitate by passing nitric oxide through a dilute solution of bichromate of potash, and, without washing it all, pressed it between folds of filter-paper, dried it by exposure to the air, and analysed it by Rose's method, given above, with the following result:—

Cr_2O_3	=28·55 per cent.
CrO_3	=29·33 ,,
HO (by difference)	=42·12 ,,

The object of this analysis was to prove that, even when the precipitate was contaminated with the chromates of the filtrate, the proportion of the chromic acid to the chromic oxide fell far below that which would exist in a compound containing two equivalents of chromic acid to one of chromic oxide, thus making it probable that the true formula of the precipitate is $Cr_2O_3CrO_3$.

(To be continued.)

TECHNICAL CHEMISTRY.

On the Metallurgical Importance of Aluminium, by M. CH. TISSIER.

THE author again calls attention to the alloys of aluminium with copper. The valuable properties of aluminium bronze are well known, and it seems that the trifling proportion of one per cent. of aluminium exerts a very serviceable effect on copper. Copper thus alloyed does not oxidise during tapping, and can be moulded into forms the surface of which remains brilliant.

According to M. Tissier, the alloy of 99 of Minesota copper and 1 of aluminium, compared to pure copper (doubtless the same copper), gives, in testing the flexibility of a round bar of 0·050 by 0·006 millimètres, the following results:—

	Kilogrammes.
Copper with 1 per cent. of hammered aluminium	19
Pure copper, wire-drawn	7
Brass, wire-drawn	8

These weights indicate the limit of elasticity. A ternary alloy gave the following results:—

Copper.	Tin.	Aluminium.	Kilogrammes.
96	4	0	4
96	4	1	10
96	4	1	16

Ordinary cannon bronze (copper 89, tin 11), melted, gave 10, like the second alloy in the table.

If these results are confirmed, they will prove that the proportion of aluminium may be less than that admitted by MM. Deville and Debray, and yet give excellent products.—*Répertoire de Chimie pure et Appliquée.*

On the Manufacture of Ice and Production of Cold by Means of Ethylamine and Methylamine, by M. TELLIER.

ETHYLAMINE and methylamine, though easily prepared and not expensive, have hitherto remained unutilised. In relation to the special end which I have in view, their properties are of the highest importance. In fact, liquids at about the ordinary temperature, these amines are soluble in water in such proportions that the vapour of methylamine is twice as soluble in it as ammoniacal gas. The feeble tension of these vapours admits of the construction of apparatus, having to support an internal pressure hardly greater than that of the atmosphere.

I have appreciated for my purpose the advantages of this special property. In fact, having been for two years engaged in the manufacture of ice by ammonia, by methods which, in concert with my coadjutors MM. Haussmann, sen., and Budin, I have had the honour of describing to the Academy, I have seen how much the high pressures of ten, twelve, and sometimes fifteen atmospheres, necessitated by the use of this gas, require care in the construction of the apparatus, and at the same time I appreciate the danger of confiding them to inexperienced hands. Impressed with this view, I have especially studied sulphurous acid, and have been enabled to set up an apparatus supporting only from three to four atmospheres. The question of security was partly resolved previously; now it is quite so by the application forming the subject of this communication.—*Comptes-Rendus*, liv. 1188.

Contributions to the Metallurgy of Lead, by* WILLIAM BAKER, *Associate of the Government School of Mines, F.C.S.*

IT was shown in a paper published in the *Chemical Gazette*, October 1, 1856, that Pattinson's process of concentrating silver in lead by crystallisation accomplished, at the same time, a separation of copper, the latter being found in the larger proportion in the fluid lead which had been drained from the crystals. It was supposed, therefore, that this method offered a valuable means of preparing an inferior quality of lead for those purposes in the arts for which a metal of the greatest purity attainable is required.

It might seem to the uninitiated that the lead then operated upon was already sufficiently pure for all practical purposes, the quantity of copper it contained amounting to only 0·0154 per cent., or 5 oz. 0 dwt. 14 gr. per ton. Neglecting the small quantities of iron, sulphur, and silver, we will confine our attention to the copper, which is the most objectionable impurity that has to be removed.

For a long time certain "brands" of lead have been preferred to all others for such purposes as making white lead and glass-makers' red lead. We may instance the lead made from the Snailbeach Mines, in Shropshire, which has enjoyed a reputation for making good red lead for glass-makers. The best selected lead of the Northumberland district has also been much sought after

* From the *Philosophical Magazine*, vol. xxiii. p. 534.

by the manufacturers of white lead. Happily, we are now emancipating ourselves from the fashion of ascribing peculiarities in the smelted metal to the "nature of the ore." This term is perhaps useful enough in the mouth of the practical smelter, when explaining how the charge is worked in the furnace, but in all cases it may be translated into more precise language by a due methodical and scientific inquiry. As the most remains to be known about iron of all the common metals, it is exceedingly probable the "nature of the ore" will have, for some time to come, to account for the nature of the pigs introduced.

A very small quantity of oxide of copper in the red lead is found to impart a bluish shade to flint-glass. In some cases it can hardly be pronounced blue, but at least the glass is wanting in the pure watery lustre which is the perfection of "cristal." It is almost incredible that so small a proportion as three ounces per ton, or 0·009 per cent., should impart an undesirable tint; yet the evidence upon this point is conclusive. Some facts in reference to white lead making will, however, quite corroborate this statement. In making carbonate of lead by the method of fermenting tanners' bark and acetic acid vapour, the corroded or converted lead often presents a delicate pink tint. Close observation has shown me that this is invariably connected with the presence of copper. Where the air has had more free access, the pink colour disappears, or is replaced by a far more delicate blue, indicating the passage from suboxide of copper (Cu_2O) to protoxide of copper (CuO). Finally, pure lead, specially prepared, which gave repeatedly pure white corrosions on receiving the addition of a very small proportion of copper, exhibited the characteristic pink tint when again submitted to the action of the corrosive vapours. Providing the lead is otherwise pure, a proportion of only 2¼ ounces per ton, or 0·0071 per cent. of copper is sufficient to produce a delicate but decided pink hue. Should antimony or sulphur be present, the colour is somewhat masked, and a dull-coloured white lead is produced. That the presence of iron has nothing whatever to do with this appearance is manifest from the fact that the lead containing only an inappreciable trace of copper which gave pure white corrosions, contained quite as much iron as the specimens which afforded pink corrosions.

Proceeding upon the results given above, Derbyshire lead, which, when properly smelted, contains from two ounces to five ounces of copper per ton, was crystallised three or four times, and produced remarkably pure lead. Numerous analyses have confirmed the fact, that in dealing with a metal containing up to five ounces or perhaps seven ounces per ton, the copper is always concentrated along with the silver. But a most remarkable fact was discovered upon applying this method of purification to lead containing above ten ounces of copper per ton.

Five tons of lead, containing 0·0774 per cent. of copper, or twenty-five ounces per ton, were submitted to Pattinson's process. At the fourth operation, the following was the distribution of copper in the charge:—

	Per cent. Copper.
Crystals	0·0574
Fluid lead drained from the crystals	0·0526

At the sixth crystallisation:—

	Per cent. Copper.
Crystals	0·0642
Fluid lead	0·0570

Proving that no concentration of copper in the fluid portion had taken place. The lead, which was otherwise soft and fit for all ordinary purposes, such as rolling into sheets and making pipes, possessed a surface unmistakeably different from that of the purest lead, the most marked difference being a somewhat irregular depression or crumpling in a line along the direction of the length of the mould. Other experiments with lead containing various proportions of copper have shown that when the quantity is above a certain limit, which can only be more accurately defined when a large number of analyses have been made, the crystallisation process cannot be economically employed. It still remains, however, a useful adjunct to refining operations, when the lead operated upon has been smelted from ore carefully selected to exclude the more coppery kinds. Lead smelters, besides, might do much for the purity of lead if their charges were worked in such a manner that, with good ore, by keeping the temperature as low as possible, even at the sacrifice of the yield of metal, most of the copper would go into the slags. These would yield equally good common lead, and the reputation of the smelter would be so much increased by the higher degree of purity of the selected lead. It is to be feared that, in the attempt to get the utmost out of the ores at the *first* operation, they have often deteriorated from the quality of metal produced in former times.

PHARMACY, TOXICOLOGY, &c.

On the Alkaloid contained in Veratrum Viride, by S. W. Abbott, *M.D., Woburn.*

The properties of veratrum viride have led many to suppose that it owed its power to some active principle, perhaps veratria, an alkaloid which has hitherto been obtained from the seeds of a Mexican plant of the same natural order.

On hearing the statement made during the present winter, in the lectures on arterial sedatives, that the active principle of this plant had not yet been determined, I was somewhat curious to investigate the subject and ascertain, if possible, whether its active principle were really veratria, or if it bore any similarity to it.

In making the trial, I made use of the mode given in the *Edinburgh Pharmacopœia*, preferring it to that of the *U. S. Pharmacopœia*, on account of its greater simplicity. The process is as follows, with the exception that in place of tincture of cevadilla seeds, the tincture of veratrum viride root was substituted:—Four ounces of the tincture were concentrated by slow evaporation over a water bath, until a deposit began to be formed. The residuum was poured, while hot, into twelve times its bulk of cold distilled water. This was filtered through calico, and the residuum on the filter washed, so long as the washings precipitated with liquor ammonia. The filtered liquid and the washings were united, and an excess of ammonia added. The precipitate was collected by filtration, washed with cold water, and dried by means of imbibition and the vapour bath. A slight additional amount was also obtained by evaporating and cooling the remaining ammoniacal liquid.

The result obtained by this process was a brownish powder, in amount about two and a-half grains. The same process was tried with four ounces of the tincture of the seeds already mentioned, and a similar powder was obtained, somewhat lighter in colour, and in amount about three-quarters of a grain.

The alkaloid thus obtained is soluble in strong alcohol, but insoluble in water. The following reactions were

obtained by chemical tests:—A dark orange-red colour on adding a drop of sulphuric acid; a portion dissolved in dilute acetic acid gave a white precipitate with liquor ammonia. These reactions are also characteristic of veratria, a quantity of which I had procured, in order to compare the two together.

Under the microscope, with a power of 300 diameters, the following appearances were noticed:—Having dissolved a small portion of each in water acidulated with acetic acid, a few drops of sulphuric acid were added. This solution was partially evaporated at a gentle heat, and a drop of each placed on a slip of glass. The microscope revealed a multitude of beautiful acicular crystals. The crystals obtained from these two solutions are very similar, though more slender and beautiful in that obtained from the officinal veratria than that from the nameless product in question. A similar result was obtained by the action of hydrochloric acid, except that the crystals were in both cases shorter and thicker, and some of them disposed to assume the shape of hexagonal prisms.

After trying the above reactions, hardly a homœopathic portion of the original amount remained with which to test its physical properties, but there was a sufficient amount to induce considerable sneezing, and also an acrid bitter taste when taken into the mouth. The remainder, thoroughly mixed in lard, produced a slight redness of the skin when rubbed upon the surface.

These facts, when taken together, would seem to prove that these two alkaloids, if not identical, are yet very similar in their natures.

PHYSICAL SCIENCE.

On the Spectrum Afforded by Solution of Nitrate of Didymium. (From a letter of Professor O. N. Rood to Dr. Wolcott Gibbs.)

You will remember calling my attention to the curious fact that Gladstone had discovered two dark lines in the spectrum furnished by light transmitted through dilute solutions of the nitrate of didymium.

I have lately repeated the experiment with the sample of this substance you kindly placed at my disposal, using quite strong solutions of considerable thickness.

When the light of a lamp or sunlight is transmitted through a tube twelve inches in length, containing a strong solution of the salt in question, and afterwards analysed by the spectroscope of Bunsen and Kirchhoff, the spectrum is seen crossed by twelve distinct lines or bands, some being very broad, while others are quite fine, and require a prism of high dispersive power to effect their resolution.

D, or the sodium line, is just cut off by one of these broad bands, and from this results the singular circumstance that the sodium flame becomes invisible when merely viewed through a foot of the solution, though white objects examined in the same manner appear but slightly altered in tint. This, I think, is the only case we know of where the orange ray is cut off by a nearly colourless medium.—*American Journal of Science.*

NOTICES OF PATENTS.

1733. *Barometers.* T. T. MacNiell. Cockspur Street, London. Dated July 9, 1861.

The construction of the barometer which forms the subject of this invention is so arranged as to indicate much more conspicuously than in the ordinary forms of instrument any slight variations in the height of the barometric column. The glass tube is made of a greater length, and much wider at the upper part, than usual, whilst the lower extremity, left open, is surrounded with a casing of glass or other material which is capable of serving as a float in the cistern of mercury. This tube is filled with mercury and then inverted in the ordinary manner, when a vacuum will be formed in the upper enlarged part of the glass tube. If the tube is then left to itself it will sink into the mercury contained in the cistern until the buoyancy of the immersed part of the float at the bottom of the tube balances the pressure of the atmosphere on the top of the tube, plus the weight of the tube itself, when the tube will float or be suspended in the mercury contained in the cistern. The glass tube is maintained in its upright position by fixed rings through which it passes, which rings have pointed set screws or other contrivance having the effect of diminishing the friction and guiding the tube during its vertical motion. By the arrangement above described, accordingly as the pressure of the atmosphere increases or diminishes, not only does the mercury rise or fall in the tube to the usual extent, but the tube itself sinks or ascends to an extent varying with the proportion between the inside sectional area of the upper enlarged portion of the tube and the sectional area of the float immersed in the cistern of mercury.

1748. *Manufacture, Application, and Combustion of Gases.* J. Kidd, Strand, London. Dated July 11, 1861. (Not proceeded with.)

The apparatus described in the specification is precisely the same in principle as that by which hydrogen is prepared and stored in the Döbereiner lamp, and other contrivances devised many years ago, and constantly applied even at the present day. Mr. Kidd directs that a lump of zinc should be suspended under the bell receiver of a gas-holder, and that the outer tank be filled with dilute acid, in order to obtain a constant supply of hydrogen, which is burned either in the condition in which it is generated, or the jet of gas may be rendered luminous by impregnation with the vapour of naphtha or benzole.

1765. *Improvements in the Method of Soldering together Two or more Printing Type Letters, to facilitate the work of the Compositor.* L. George, Paris. Dated July 13, 1861. (Not proceeded with.)

This invention consists in a mode of soldering together two or more letters that occur most frequently in words in the English language. For this purpose an amalgam is prepared of two parts of mercury and one of tin, a little of which is rubbed over the surface of a plate of lead, upon which the broad side of the type letters to be joined is then firmly pressed and held till rigid, which will occur in the course of about half an hour.

1775. *Glass, Pottery, Porcelain, and other Ceramic and Plastic Wares.* J. C. Coombe and J. Wright, Bridge Street, Blackfriars, London. Dated July 15, 1861.

The patentees claim the application of the fluo-silicates and artificial silicates of the alkalies, alkaline earths, and other earthy bases, to the manufacture of glass, pottery, porcelain, and other ceramic and plastic wares; and, more particularly, the substitution of the fluo-silicic salts for the phosphoric compounds of the same bases which are commonly used in the before-named manufactures.

These identical compounds were permitted to be included in the specification of T. Cobley, who on the same day (July 15, 1861, No. 1776) patented the special use of the silicate and fluo-silicate of baryta, both for glazing porcelain and in the manufacture of glass. How does it happen that letters patent are freely granted, in immediate succession, to different individuals for the self-same

application? Both inventors cannot, surely, urge the claim of novelty.

1783. *Extracting the Fibres from Genista Scoparia (Broom), and their Application to Manufacturing Paper and Fabrics, and also Treating the Washing Waters so as to obtain Dyeing Products therefrom.* E. G. De la Provotais, Paris. Dated July 15, 1861.

The patentee claims, firstly, the preparing ligneous fibres from *Genista Scoparia* (broom) for the manufacture of paper, pasteboard, and also of fibres intended to be converted into textile fabrics. Secondly, the economisation of the colouring matters in the washing waters remaining after treatment of the fibres.

The idea of converting the vegetable fibres of broom into paper is not original, more than one patent having already been taken out in this country for the same application.

1790. *Improvements in the Manufacture of Soda, Carbonate of Soda, and Hydrochloric Acid; and in apparatus connected therewith.* J. P. Gillard, Paris. Dated July 16, 1861. (Not proceeded with.)

This proposition refers to a method of decomposing common salt by passing a current of superheated steam, hydrogen, carbonic oxide, or other reducing gas over the same at a high temperature. Under these circumstances hydrochloric acid is said to be evolved, for the condensation of which suitable apparatus is provided. The saline mass left in the retort at the end of the operation consists of the carbonate or caustic soda, accordingly as one or other of the gases before mentioned may have been employed.

This method, although it professes to simplify the manufacture of soda, is not likely to supersede the old process in which sulphuric acid is employed to effect the decomposition.

1792. *Certain New Alloys of Silver with other Metals, and the Processes employed in their Manufacture.* C. D. Abel, Southampton Buildings, London. A communication. Dated July 18, 1861.

This patent claim has reference to the introduction of nickel, manganese, and in some cases also of phosphorus, into the alloys of silver. Other claims in the specification refer to the employment of the ferro- and ferri-cyanide of potassium in the process of purifying the nickel by galvanic or other agency, or for the purposes of a flux in the formation of these alloys.

Grants of Provisional Protection for Six Months.

2069. James William Green, St. Paul's Buildings, Little Carter Lane, London, "An improved method of cutting sheet and plate glass to any given design, giving the finished form the brightest polish possible."—A communication from Carl Heckert, Kronen Strasse, Berlin.—Petition recorded July 21, 1862.

2191. Edward Brown Wilson, Parliament Street, Westminster, and Maurice Picard Lyons, France, "Improvements in the manufacture of iron and steel."—Petition recorded August 2, 1862.

2213. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in blast furnaces."—A communication from Daniel Schwabe, Terre Noire, St. Etienne, France.

2233. Alexis Jean Moreau and Adolphe Ernest Ragon, Bernard Street, Russell Square, London, "Improvements in the mode of and apparatus for treating bituminous and carbonaceous substances for the purpose of obtaining the various products, volatile, liquid, and solid, which they contain, and also in the treatment and application of such products."

2235. Thomas De la Rue, Westbourne Terrace, London, "Improvements in the manufacture of pigments and writing inks."—Petitions recorded August 9, 1862.

2249. Alfred Joseph Martin, High Street, James Goss, Prospect House, Bow Road, and John Bush, Bow Common, Bromley, Middlesex, "Improvements in apparatus for distillation."—Petitions recorded August 11, 1862.

2253. James Dickson, Tollington Road, Holloway, London, "Improvements in treating zinc ores and solutions of zinc to obtain zinc therefrom."

2257. Alexander Delrue, Dunkirk, France, "Improvements in compositions for preventing and removing incrustation in boilers."

2265. James Dickson, Tollington Road, Holloway, London, "Improvements in the manufacture of chlorine for commercial purposes."

2275. Louis Desire Verstraet and Etienne Maurice Olivier, Boulevart St. Martin, Paris, "A new process of manufacturing carbonate of soda by the application of sulphuret of sodium, and in apparatus for the same."

2277. William Schnell, Charlotte Street, Fitzroy Square, London, "Improvements in extracting the sulphur and sulphurous acid from the oxysulphuret of calcium, which is contained in the residues or waste material obtained in the manufacture of soda."—A communication from Ludwig Mond, Hesse Cassel, Germany.—Petitions recorded August 13, 1862.

2295. John Sanders Blockey, Hyde Park, Leeds, Yorkshire, "Improvements in the manufacture of colouring matters."

2315. John Thomas Oakley, Grange Road, Bermondsey, Surrey, "Improvements in heating stoves employed for drying and other purposes."

Notices to Proceed.

1252. William Clark, Chancery Lane, London, "An improved method of preserving animal and vegetable substances."—A communication from Mr. Jules Réné Lion, Boulevart St. Martin, Paris.—Petition recorded April 29, 1862.

1268. George Davis, Serle Street, Lincoln's Inn, London, "An improved electric apparatus, applicable to various useful purposes."—A communication from François Ferdinand Auguste Achard, Paris.

1528. William Petrie, Charlton, Kent, "Improvements in vessels for boiling chemical products, as sulphuric acid, and in apparatus for indicating the degree of concentration and temperature of such products in the boiler, which apparatus is applicable to other pyrometric purposes."—Petition recorded August 20, 1862.

1883. Charles Cochrane, Ormesby Ironworks, Middlesborough-on-Tees, Yorkshire, "Improvements in the manufacture of aluminate of soda and potash."—Petition recorded June 27, 1862.

2025. Frederick Major Parkes, Plumstead, Kent, "Improvements in the manufacture of gas for lighting and heating, and in apparatus employed in the said manufacture."—Petition recorded July 14, 1862.

CORRESPONDENCE.

Substitutes for Cotton.

To the Editor of the Chemical News.

Sir,—In a recent Number of the Chemical News (August 2, 1862), you published a very interesting notice, signed "H. H.," of the "Uses of the Indian Madar as a Substitute for Cotton." We have several American *Asclepiadaceæ* whose stems yield a strong fibre, while the pods contain floss precisely similar to that of the Indian Madar, and we have lately been bringing together, in the Botanic Garden here, the most likely species, with a view to experiment. One lately sent by Viscount Monck is highly spoken of by Dr. Hart, an experienced cotton grower, who obtained it on the Rocky Mountains. It would be a great favour if you could allow me to examine a small morsel of the cloth referred to by "H. H." as made either

wholly or partially from the Madar floss. From his description it seems to have been manufactured in a different manner from some I previously heard of. Your correspondent offers additional information on this subject, and I am sure it would be very acceptable to many of your readers. If any manufacturer would undertake to spin and weave some of our Canadian Asclepias fibre or floss, we should be glad to send enough to make a trial.—I am, &c.

George Lawson, Ph.D., LL.D.
Prof. Chem. and Nat. Hist.
Laboratory, University of Queen's College, Kingston, Canada.

Artificial Tourmalines.

To the Editor of the Chemical News.

Sir,—I should be much obliged if any of your correspondents would kindly inform me of the best method of forming "Herapath's Artificial Tourmaline." I have all the materials at hand, and am also familiar with chemical manipulation.—I am, &c.

An Amateur.

MISCELLANEOUS.

PRECIOUS STONES AT THE SOUTH KENSINGTON MUSEUM.

Among the treasures of Art on loan now exhibiting at the South Kensington Museum are several gems very interesting from a mineralogical point of view. We have noted a few of the more remarkable.

In a case contributed by E. Waterton, Esq., will be found a late Roman finger ring, in which two uncut crystals of diamond are mounted; it is labelled "A Rare Example," and one of the diamonds is certainly a very beautiful octohedral crystal, both summits and the edges being nearly perfect. The stone is by no means an insignificant one as to size. Six magnificent pale green diamonds, varying slightly in colour, but of great brilliancy and rarity, are exhibited by A. J. Beresford Hope, Esq.

"Le Saphir Merveilleux" is certainly a splendid specimen as regards excellence of form and purity and richness of colour; it is, in fact, faultless. Among the magnificent jewels in the French Deparment of the International Exhibition may be seen a much larger sapphire termed "Le plus beau Saphir du Monde;" though very remarkable for colour, and, above all, for its enormous size, in form it is less perfect than the specimen at the South Kensington Museum. The latter is said to appear of an amethystine colour by candlelight, a phenomenon not unusual with many blue substances, into the tint of which, in reality, much red often enters. There are several other sapphires in the collection, some being studded in a reliquary in the form of a foot; one stone of unusual purity of colour being included in Mr. Waterton's unique collection of rings to which we have before referred.

As connected with the sapphire, we may here refer to the enormous, yellowish-green, cut crystal of beryl, mounted in a sword hilt, formerly belonging to Murat, King of Naples: it is said to be the largest known aquamarine.

The loan collection is very rich in specimens of the various beautiful forms in which silica occurs. In addition to the numerous large objects wrought out of rock crystal, we may draw attention to the matchless examples of precious opal, and to the two fine specimens of the variety of chalcedony, called catseye, one being of a greenish-grey, and the other of a lustrous brownish-gold colour: both are of great size.

Though it has no place among minerals, we cannot help noticing a monster pearl, weighing 1800 grains, 2 inches long and 4½ inches in circumference. Its shape and colour are not by any means perfect. Pearls are interesting to the mineralogist from the singularity of their structure and the mystery of the formation. A thin section of pearl presents the closest resemblance to the globular crystalline concretions of carbonate of lime, of which oolite and pisolite chiefly consist, and also to the circular crystals of Rainey. Although it seems that the artificial formation of pearls may be induced by the introduction of foreign bodies, yet it is nevertheless true that sections of natural pearls seldom, perhaps never, disclose any foreign substance, but only one or more (as many as seven sometimes) *centres of concretion*, around which the deposition of matter has regularly occurred.

BOILER EXPLOSIONS.

Fires, collisions, shipwreck, and all the results of bad engineering come round in turn. If common disasters did not pale before war this would be known as the boiler explosion term. Seeing that the Government has nearly 300 steam vessels of its own; that the most momentous issues may hang on the safety of either of them, and that it can at little cost do what individuals will not—ascertain the cause and cure of a terrible and frequent disaster (boiler explosions), the attention of some board or bureau should be at once directed to this inquiry. At length the information is at hand by which the proper direction of inquiry and definite results may be ascertained; and any further delay in settling this question is inexcusable. Recent discoveries, and the narrowing down of the list of possible causes, by actual trial, have placed the great fact almost within reach. Some of the highest authorities are already satisfied. In the first place, the lately received theories of explosions appear to be exploded themselves. That electricity or any gas that can be generated in a boiler cannot account for its explosion, is settled by repeated experiment. A popular theory is "low water." It would be just as explicit to say "water." Low water is not an exploding power—it is only a circumstance. When the heating surfaces are allowed to get red hot, other phenomena may indeed occur. The steam in the steam-room may be superheated; but it appears to be a mathematical fact that there is not sufficient heat in the steam, when heated nearly to redness, to vaporise enough water to cause an exploding pressure. Or, water may be suddenly vaporised upon a red-hot metallic surface. But it is an experimental fact that there is not heat enough in all the metal thus overheated to make the steam pressure required for an explosion. Again, it is urged that explosions are only exaggerated ruptures, and that all boiler bursting is attributable to want of strength to carry ordinary pressures, with their normal variations. But the results of the two phenomena are totally different. A rupture is always in the weakest part, and just large enough to relieve over-pressure; an explosion shatters everything—strong and weak alike.

Just after the *Great Eastern's* funnel-casing exploded, a party of engineers in London were attempting, with little success, to reconcile any old theory with the phenomena here exhibited, when a new theory was proposed, which, after running the gauntlet of professional criticism, assumed such importance that Mr. Zerah Colburn, an American, and the probable author of the theory, wrote a book about it, and Mr. D. K. Clark explained it in the *Encyclopædia Britannica*. Quite recently, while experimenting for a very different purpose, Mr. Edwin Stevens, of Hoboken, developed the great fact upon which its probability depends. Water cannot exist as water under the atmospheric pressure at a higher temperature than 212°. Now, the temperature of the water in a boiler under steam pressure of 100 lb. is 330°. If, then, the steam, pressing on this water, can instantly escape, as through a rupture caused by mere weakness of the metal or by over-pressure, a great part of this water at 330° will instantly flash into steam, carrying

the rest with it at about the velocity of a cannon-ball. So far we know. The theory is that this flying body of inelastic water-particles operates like so many projectiles—like a broadside of grape—tearing into pieces everything within reach. Thus explosions start in simple ruptures, and ruptures always result from carelessness. There is no mystery about the latter fact.

But is it reasonable to attribute such terrific power to flying water drops—to mere rain? Mr. Stevens was experimenting on the resistance of water to projectiles. He filled a 46-in. horizontal cylinder-boiler two-thirds full of water, and fired an 18-pound round shot with three pounds of powder into the end of it, through the head and into the water ten inches below the water-level. The result was that the boiler burst in several places below the water-line that were weakened by corrosion; but the greatest pressure had operated over the line of fire, and a foot above the water-level. The flying mass of water thrown upward by the ball had sheared off eleven ⅞-in. rivets and opened the seam.

Even this hasty review of the present state of the science will render it evident that a few careful experiments would settle this great question. It is, of course, possible that one of the old theories may be correct. If superheated steam is an indirect cause of explosions, the remedy is so certain that carelessness cannot prevent its operation. But if malconstruction or deterioration of boilers is the beginning of explosions—and there is little room for doubt of it—then a simple law, that can hardly be evaded, would deliver us for ever from this terrific source of slaughter and loss. Let every steam boiler be examined and tested once or twice a year by competent engineers; and let every boiler be confiscated, in case the certificate of such test cannot at any time be produced.—*New York Times.*

CARDAMOMS.

How many English people know anything of cardamoms? Among the tens of thousands of daily visitors to the universal repository of products and fabrications at South Kensington, are there a hundred, or even a score, who could go straightway to the case, or even to the court, in which the article cardamom is exhibited? Tell us, well-instructed reader, replete with the contents of the official catalogues,—tell us off-hand what it is; or tell us in three guesses whether it is a sea-shell, a dried fish, or a conjuring toy—something to eat, or drink, or wear—a vegetable, mineral, or animal substance? When you have excogitated a wholesome conclusion of ignorance, go into the Indian collection at the top of the north-east staircase. There you will find, among the vegetable substances from which drinks are concocted, two or three bottles labelled with the name of the article you seek, and you may construct your own natural history of the brown husky beans, something like rough overgrown almonds, that are there set forth as the growth of Travancore and other districts of India. Perhaps in the Chemical Department you may find also a bottle labelled "Tincture of Cardamom;" and in that deep red fluid you will see the stomachic for the sake of which cardamoms are cultivated, farmed, and taxed.

Yes, farmed and taxed. The commodity of which Englishmen know so very little is an article of revenue to their Indian Government, and the collection of that revenue matter of bargain between the Government and a contractor or farmer. The affair is managed in this wise:—Once in five years the collector at Calicut puts up to auction the cardamom farm of the district of Wynaad. The district includes seven talooks on the sides of those lesser ghauts that terminate in Malabar, the western mountain chain of the peninsula. Wynaad, the chief of these talooks, giving its name to the whole, is especially favoured by nature in the matter of cardamoms. A rugged and inaccessible region—suspended, as it were, between Mysore and Malabar, and long a debatable as well as border land—it would have no commercial value but for its remarkable aptitude for the production of this pungent spice. The native rajahs gave the Company some trouble in the days of the Mysore chieftains, and the Company avenged itself by taking possession of the soil and the crops for ever. The purchaser of the cardamom farm of Wynaad acquires at once an exclusive right of taking the whole crop of cardamoms at a fixed price. The grower must gather the crop, dry and clean it, take it to a place agreed upon, and there deliver it up at the price fixed for him by the Government, usually about a fourth of the market price. The contractor may use his own weights and pay in his own coins, leaving the poor peasant-cultivator to get redress, if he can, for errors and frauds. To conceal or secretly sell any of the pods is an offence against the revenue laws and an injury to the contractor, for the prevention of which armed men watch the collection of the crop and search houses in which any of it may be supposed to be hidden. Of course the grower is a smuggler, and equally of course the contractor is a cheat and an oppressor. A transaction with the Government—the Government of Queen Victoria—has handed over the chief produce of the soil of Wynaad, the chief property of its mountainous inhabitants, to a stranger. He has bought the right to rob them with impunity, taking without their leave every grain of their principal crop, paying them for it a third or fourth of what it would fetch at the nearest town, and punishing them if they attempt to withhold but a single bag of their own produce. And after having made a profit of thousands of rupees out of the rapacity of the contractor and the helplessness of the grower, the Government stops the export of the crop until it has paid toll for the privilege of going out of the country.

Structure of Copper.—Mr. W. Vivian writes to the *Society of Arts Journal*:—"I have explained that all manufactured copper showed a porous or cellular structure, and I have now to state that native copper generally shows a crystalline structure; indeed, like all copper the produce of cementation, our native coppers are an aggregation of crystals. The structure of the native copper of the Lake Superior district of North America is, however, very different from other native or manufactured copper; it is neither cellular nor crystalline, but dense, ductile, and wiry in structure, giving the idea of its having been moulded and forced into its present shape while in a cold state, and in this respect it perfectly resembles native gold and silver; and it is remarkable that the same copper when once melted assumes the cellular structure of all other manufactured copper. Now it seems to me that the proper inference to be drawn from the above peculiarity in structure is, that this native copper is not deposited from a solution like our native copper, neither was it deposited under the agency of fire, else it would have been either crystalline or cellular in structure, unless it has undergone some other very material change."

Combustibility of Petroleum.—The following letter on the "Combustibility of Petroleum," from Dr. Robert Angus Smith, F.R.S., F.G.S., &c., the eminent chemist, so well known to the world by his valuable researches on the "Air and Water of Towns," appears in the *Manchester Examiner and Times*:—"Sir,—The experiments at Liverpool on this subject, spoken of by you last week, are, no doubt, very valuable, as a portion of a number to be made, but if taken by themselves they seem to establish nothing. You did not inform us of the evaporating point of the oils, and we do not, therefore, know definitely on what substances the experiments were made. If the oil burnt on the cold ground it must have been a very dangerous specimen. The absence of very violent explosion is not remarkable. Explosion takes place when the vapour is mixed with air, and this occurs chiefly when there is evaporation in

an enclosed space. Experiments made in the open air do not necessarily cause explosions. The two great facts to be remembered respecting the volatile petroleum are: First—That the vapour rising at the ordinary temperatures ignites readily, and when mixed with air explodes. It mixes with air like gas, and in this lies its hidden danger. Secondly—When water is thrown on the oil, the oil floats on the water and still burns; whereas spirits mix with water, become diluted, and cease to burn. Having made many trials of these oils, I thought it well to guard against some of the conclusions drawn from the experiments alluded to.—I am, your obedient Servant, R. Angus Smith. —August 20, 1862."

Rice Glass from Japan.—Last week,* in describing the rice glass in the Japanese collection, I gave the account of it which I received from the attendant at the stall. Since then I have, through the kindness of Messrs. Hewett and Co., of Fenchurch Street, obtained a sample of the article in question, and submitted it to an analysis which enables me to correct the previous statement and to add some further particulars. I stated in the previous article that I suspected the rice glass to be a peculiar combination of silica with vegetable albumen. In order to put this idea to the test, I submitted the glass to the action of a small blowpipe, when it readily fused without the slightest indication of containing organic matter. The story, too, about its having been prepared by means of water, is obviously false, since, had that been the case, it would at least have contained enough of the water of hydration to cause it to split and crumble under the flame of the blowpipe. My impression now decidedly is, that the glass in question is simply a very fusible form of glass prepared in the ordinary way by ignition. In the warehouse of the Messrs. Hewett I saw a screen in which these glass rods were packed side by side in a frame so as to resemble a sheet of ribbed glass. I mentioned before that the Japanese are unacquainted with the art of making plate glass, and take this queer plan of forming a transparent sheet of glass by putting a great number of small rods close together. That it should have got the name of "rice glass," and had appended to it the queer legend I have noticed, is not at all surprising, as everything out of the way which comes from China is set down as rice in a new form. There is a material, much used by the Chinese, for pictures and other purposes, called "rice paper," which has as little to do with rice as the glass has. The paper is made from the bark of a plant called the *Æschynomene paludosa*, well known to botanists.—*The Engineer.*

The Decimal System of Weights and Measures.—The Report of the Select Committee appointed to consider the practicability of adopting a simple and uniform system of weights and measures has just been published. The following recommendations are laid before the House, together with a great mass of evidence and tabular appendices:—"1. That the use of the metric system be rendered legal. No compulsory measures should be resorted to until they are sanctioned by the general conviction of the public. 2. That a Department of Weights and Measures be established in connection with the Board of Trade. It would thus become subordinate to the Government, and responsible to Parliament. To it should be entrusted the conservation and verification of the standards, the superintendence of inspectors, and the general duties incident to such a department. It should also take such measures as may from time to time promote the use and extend the knowledge of the metric system in the departments of Government and among the people. 3. The Government should sanction the use of the metric system (together with our present one) in the levying of the Customs' duties; thus familiarising it among our merchants and manufacturers, and giving facilities to foreign traders in their dealings with this country. Its use, combined with that of our own system, in Government contracts has also been suggested. 4. The metric system should form one of the subjects of examination in the competitive examinations of the Civil Service. 5. The gramme should be used as a weight for foreign letters and books at the Post Office. 6. The Committee of Council on Education should require the metric system to be taught (as might easily be done by means of tables and diagrams) in all schools receiving grants of public money. 7. In the public statistics of the country quantities should be expressed in terms of the metric system in juxtaposition with those of our own, as suggested by the International Statistical Congress. 8. In private Bills before Parliament the use of the metric system should be allowed. 9. The only weights and measures in use should be the metric and imperial, until the metric has been generally adopted. 10. The proviso in the 5th and 6th William IV. cap. 63, clause 6, allowing the use of 'local and customary measures' in cases where the vessel employed 'is not represented as containing any amount of imperial measure or of any fixed local or customary measure heretofore in use,' should be repealed as giving facilities to evade the statute. 11. The department which it is proposed to appoint should make an annual report to Parliament."

Closing Fruit Jars.—For the preservation of all kinds of fruits, use glass bottles or jars. Select those of even thickness, or rather of even thinness, for they are often exposed to considerable heat, and while they should not be so thin as to break in common handling, or burst from internal pressure caused by fermentation, still they should not be thick, or of pressed glass, when blown-glass jars can be readily obtained. So much for the bottles. Now as to closing them air-tight, we know corks will not do it. The very structure of the substance is against it, unless cork of the most velvety character is obtained, and this is costly. We recommend waxed cloth tied over the jar as a substitute at once cheap and effective, and have never found anything superior to it. Prepare the cloth in this way:—Melt together some resin, beeswax and tallow in equal parts; tear the cloth in strips four inches wide, or, at least, wide enough conveniently to tie over the mouth of the jar, and dip these strips, drawing them through the hot wax and stripping nearly all the wax off. With cloth thus prepared, after the jar is filled with hot preserves, and while still hot, close the mouth and bind it on with good linen cord. Then with shears trim off as much of the waxed cloth as is desirable, and then dip it in some melted wax, which should be made with only about half as much tallow. Sealing-wax may be used instead if desired. The jars should be put where the wax will cool at once, so that the exhaustion caused by the cooling of the preserves and the condensation of the steam, may not cause the wax to run through the cloth. Nothing can be more thoroughly air-tight than bottles so prepared.—*Homestead.*

* Chemical News, Vol. vi., p. 131.

ANSWERS TO CORRESPONDENTS.

Mandioco.—*A Reader* would feel obliged if any of our correspondents would give him information about the substance called *mandioco* by dyers.

F. A. W.—The article called *constant white* by artists, is calcined sulphate of baryta.

A Dyer.—Stannate of soda contains nine equivalents of water of crystallisation. Some of these go off when the salt is exposed to the atmosphere.

A Constant Reader.—The present state of science is not sufficient to explain the difference between amorphous and ordinary phosphorus.

An Amateur.—The best selenite for splitting comes from Montmartre, near Paris. "Quekett on the Microscope" will give you the desired information.

Chemicus.—The oxalate of chromium and potassa forms beautiful crystals. They are correctly described in "Fowne's." The term *crystal* should never be applied to a scaled preparation.

THE CHEMICAL NEWS.

VOL. VI. No. 146.—September 20, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by FRANK H. STORER *and* CHARLES W. ELIOT.*

(*Continued from page* 138.)

To determine the exact proportions of chromic oxide and chromic acid in the original substance evidently requires a different process of analysis, and the third method of analysis before described is applicable to this purpose, with this advantage over the case to which we first applied it, that the precipitate separates from such a dilute solution as to carry but a small proportion of soluble salts into the wholly unwashed deposit. The following are the figures of such an analysis of the precipitate pressed between folds of filter-paper without washing, and air-dried :—

	Grammes.
Weight of reduction-tube + precipitate	9·1856
Weight of reduction-tube	8·5520
Weight of precipitate	0·6336
Weight of reduction-tube after ignition	8·9342
Loss by ignition	0·2514
Weight of residue	0·3822
Weight of CaCl tube after ignition	17·6352
Weight of CaCl tube before ignition	17·4210
Weight of water	0·2142
Weight of oxygen = ·2514—·2142	·0372
Weight of crucible + Cr_2O_3	35·0227
Weight of crucible + filter-ash	34·7345
Weight of Cr_2O_3	·2882
Weight of soluble salts = ·3822—·2882 =	·0940

(Equiv. Cr_2O_3) : (Equiv. O) = (Cr_2O_3 found) : (1 equiv. O).

The proportion 76·48 : 8 = ·2882 : x = ·0302 gives the theoretical amount of oxygen necessary to bring the chromic oxide found up to the composition expressed by the formula $Cr_2O_3CrO_3$ at 0·0302 gramme; the oxygen actually found was 0·0372 gramme, being seven milligrammes in excess of the theoretical amount. When it is remembered that the unavoidable loss in the water determination, however small, tends to increase the amount of oxygen found, and that the loss in the chromic oxide determination tends to decrease the theoretical amount of oxygen, a discrepancy of only seven milligrammes will be considered allowable. A second analysis of the same precipitate by the same method gave even a nearer result, viz. :—

	Grammes.
Oxygen required to raise the Cr_2O_3 found to the composition $Cr_2O_3CrO_3$	0·0235
Oxygen actually found	0·0264

These two analyses, in connection with the preceding determinations by the other methods, seem to us to prove conclusively that the precipitate produced by passing nitric oxide through a solution of bichromate of potash is a chromate of chromic oxide, having the formula $Cr_2O_3CrO_3$. Schweitzer expressed his conception of the reaction by the formula—

$$4\,(KO_2CrO_3) + 2NO_2 = 2\,(KOCrO_3) + 2\,(KNO_5) + 6\,(CrO_2)\,;$$

we shall write it, in accordance with the results of our analyses,

$$2\,(KO_2CrO_3) + NO_2 = KNO_5 + KOCrO_3 + Cr_2O_3CrO_3.$$

3. The same partial reduction of the chromic acid in bichromate of potash, which in the reaction just described is effected by nitric oxide, may be accomplished by alcohol with the aid of light. The precipitate so produced has been analysed by Vogel,† who assigns to it the composition which would be expressed by the formula $Cr_2O_3CrO_3$, though, for reasons hereafter to be considered, he seems to prefer the formula CrO_2. The precipitate thus obtained by alcohol‡ is identical in colour and texture with that produced by nitric oxide, or by the double reaction between a neutral salt of chromic oxide and monochromate of potash. It is unnecessary in this connection to refer to the well-known reduction of aqueous chromic acid by sulphurous acid, by certain organic acids, by alcohol, and by paper; light and heat facilitate the reduction, and the brown chromate of chromic oxide is often produced when the reduction is but partial.§

4. Again, the chromate of chromic oxide may be obtained by the oxidation of the hydrate of chromic oxide. When pure hydrated chromic oxide is treated with chlorine water, the oxide is converted into the brown chromate of chromic oxide, provided that the quantity of chlorine water be not sufficient to effect the solution of the chromate of chromic oxide formed in the chlorhydric acid which results from the reaction. Of course, the chromate of chromic oxide cannot be prepared for analysis in this way, because a mixture of substances is the result to be expected from the incomplete reaction. Again, the partial oxidation of hydrated chromic oxide may be effected by exposing it for a long

* Read before the American Academy of Arts and Sciences.

† *Journ. prak. Chemie*, lxxvii. 482 (1859), and Dingler's "Polyt. J.," cliii. 391.

‡ We desire to correct a serious misprint in Vogel's note, as given in the *Journal für praktische Chemie* (lxxvii. 482), and thence transferred into Kopp and Will's "Jahresbericht für," 1859, page 171. In the second line of the article, "ammoniak" should be "alkohol." We trust this correction may save others the trouble we took before it occurred to us that the error was a typographical one, in endeavouring to verify or account for the marvellous statement that bichromate of potash was reduced by ammonia. The word is correctly printed in the abridgment of the same article given in *Dingler's Journal*, cliii. 391.

§ "Gmelin's Handbook" (Cavendish Soc. Ed.), iv. 19.

time to a temperature above 200°, but below redness, with free access of air.‖

The most precise statement on this subject has been made by Krüger,¶ whose main purpose was to prove that the glowing of ignited chromic oxide was due to the sudden escape of oxygen absorbed at a lower temperature, but who incidentally maintains that this absorption of oxygen gives rise to a definite oxide of chromium whose formula is CrO_2. We think to be able to show, first, that no definite compound whatever is formed during this imperfect oxidation; secondly, that the substance which really results from the prolonged heating contains chromic acid, and is an indeterminate approximation to the body whose formula is $Cr_2O_3CrO_3$. It is obviously impossible to expose all parts of a substance in powder, like the hydrated chromic oxide, to the uniform action of the same quantity of air at the same temperature for the same time, and the limits of temperature between which the desired absorption of oxygen will take place most readily are not very clearly defined. Under these circumstances we should expect to obtain, not a definite compound, but a mixture, and the figures of Krüger's own analysis fully confirm this expectation. Krüger found 63·70 per cent. of chromium and 36·30 per cent. of oxygen in the body which he analysed; the supposed oxide of chromium, CrO_2, would contain 62·12 per cent. of chromium, giving a discrepancy of 1·58 per cent. between the chromium of Krüger's substance and the chromium of the imaginary CrO_2. This does not seem an inadmissible error, till we observe that the whole difference between the chromium in chromic oxide (68·62 per cent.) with which Krüger began, and the chromium in the supposed higher oxide CrO_2 (62·12 per cent.), is only 6·50 per cent., and that his error of 1·58 per cent. in the amount of chromium is, therefore, nearly 25 per cent. of the whole difference between the bodies Cr_2O_3 and CrO_2. With so fatal a discrepancy between the actual and the theoretical figures, it is of course impossible to maintain that a definite oxide is obtained by such an indefinite process. We pass to the second point, the existence of chromic acid in imperfectly oxidised chromic oxide. Krüger thought to disprove the presence of chromic acid by heating the substance with sulphuric acid and common salt; no chromate of chloride of chromium being visible, he inferred the absence of chromic acid. This test is at best but an unsatisfactory one when applied to a very insoluble substance containing only a small proportion of chromic acid, and there seems to be no reason for trusting to a coarse reaction in a difficult case when very delicate tests are at hand. By heating hydrated chromic oxide for five hours at a temperature varying between 200° and 210°, we obtained a brownish black powder, which dissolved with great difficulty in dilute acids, communicating a dark yellow colour to the liquid. Digested with water, the powder yielded a partial solution of a bright yellow colour, and this solution gave a very marked reaction for perchromic acid with the solution of peroxide of hydrogen.** When quickly boiled with an aqueous solution of chloride of ammonium, the filtered solution was bright yellow, and gave the reaction of perchromic acid with peroxide of hydrogen. Would it not be difficult to explain this effect of aqueous chloride of ammonium on the brown powder on the supposition that its real composition was represented by the formula CrO_2? Krüger endeavoured to strengthen his position with regard to the absence of chromic acid, by heating with common salt and sulphuric acid a precipitate prepared by mixing bichromate of potash, sulphate of chromic oxide, and ammonia, and finding, as before, no chromate of chloride of chromium; he used the precipitate in one experiment air-dried, in another dried at 110°. This precipitate was probably a mixture of chromic oxide with the chromate of chromic oxide, and, unless the last ingredient was present in very small proportion, it should have readily produced chromate of chloride of chromium. From a portion of the precipitate used in analysis *f*, we obtained without difficulty the red chromate of chloride of chromium by heating it with chloride of sodium and strong sulphuric acid. We shall have occasion to cite a similar experiment upon an anhydrous mixture of chromic oxide and chromic acid obtained by gently igniting the nitrate of chromic oxide, in which the chromate of the chloride of chromium was very readily obtained. Relying on the yellow colour imparted by the substance under examination to water and to chloride of ammonium, and on the ready exhibition of perchromic acid by means of peroxide of hydrogen, and explaining Krüger's failure to obtain chlorochromic acid by the fact that only a very small amount of chromic acid proportionally exists in the mixture, we conclude that, by long heating in the air, a part of the chromic oxide is converted into chromic acid, which instantly combines with other chromic oxide, and that the end of this process, seldom if ever attained, is the conversion of the whole mass into the chromate of chromic oxide, $Cr_2O_3CrO_3$.

(To be continued.)

‖ The partial conversion of chromic oxide into chromic acid by gentle roasting seems to have been applied in the arts years ago. Cooley, in his "Cyclopædia of Practical Receipts" (London, 1845, page 263), describes Charles Watts' process of preparing chromic acid from the oxide of chromium precipitated by lime from the residual liquor of the process of bleaching with chromic acid. The precipitate was heated evenly in a thin layer on a flat iron plate, with frequent stirring, till the mass assumed a yellow colour. If too much heat was employed, the product of this operation was easily decomposed, assuming a green colour. This process was apparently a true conversion of chromic oxide into chromic acid by roasting, and should not be confounded with the method of preparing chromate of lime described by Jacquelain (*Ann de Ch. et de Phys.* [3] xxi. 478), in which a mixture of lime and chrome-iron ore was heated to redness in a reverberatory furnace.

¶ *Journ. prak. Chemie*, xxxii. 383 (1844), and *Pogg. Ann.*, lxi. pp. 219, 406.

** Storer, *Proc. Amer. Acad.*, iv. 138, and *Journ. pr. Ch.*, lxxx. 44.

Note on Alum in Bread, and its Detection, by EDWARD ASH HADON, *Demonstrator of Chemistry in King's College.*

THERE are two methods recommended in chemical works with a view to the detection of alum in bread, to both of which there appear at first sight to be theoretical objections, rendering it difficult to understand how they could answer the purpose for which they were proposed. One method, that of Messrs. Robine and Parisot, depends on the extraction of the alum from the bread by digestion in cold water, and then testing the clear filtrate for sulphuric acid and alumina, with chloride of barium and ammonia respectively. This method seems open to the objections that the detection of sulphuric acid would not prove much, since it might have been derived from the common salt employed in making the bread; and the non-precipitation of alumina would not make its absence certain, since it might be retained in solution by organic matters extracted from the bread. The second method, that recommended by Kuhlman, consists in incinerating the bread, digesting the ash in nitric acid, and, after filtration, testing the filtrate for alumina with potash. Here, again, it seems questionable whether the alumina

would be found capable of solution in nitric acid after the prolonged incineration of the bread.

With a view to settle these points, 20 grains of alum were given to a baker to be introduced into a 1-lb. loaf of bread, which, being in the proportion of 80 grains to the quartern loaf, is probably above the average amount employed; the loaf thus prepared was broken up and macerated in successive portions of water for forty-eight hours. The expressed liquids mixed became perfectly clear by filtration through coarse paper. The filtered liquid was very feebly acid to litmus paper, rendering it by long immersion purple rather than red. One portion tested with chloride of barium, the other with ammonia, gave moderate precipitates. The great bulk of the liquid was evaporated to dryness, and ignited to get rid of a quantity of gummy organic matter. The residue, which fused readily, owing to the common salt present, dissolved for the most part in water, and wholly on the addition of a little nitric acid. Potash (pure and free from alumina) gave on addition an abundant precipitate insoluble in excess, and the filtrate remained perfectly transparent on addition of excess of chloride of ammonium, proving thus the total absence of alumina. The inorganic matters extracted by water were further examined, and found, in addition to common salt and sulphate of potash, to contain alkaline phosphates existing in the fused ash, at first as pyrophosphates, together with phosphate of lime, and a large quantity of phosphate of magnesia, which fully accounts for the precipitate obtained by ammonia in infusion of bread.

The glutinous mass of the bread left undissolved by water was then incinerated completely, when the ash was found to be wholly soluble in dilute nitric acid. Potash was then added in excess, and the whole was filtered on testing the solution with chloride of ammonium; alumina was found in abundance; the portion of the ash insoluble in potash was chiefly phosphate of iron and manganese, with a little phosphate of lime. Thus, it appears, that on treating alumed bread with water, no alumina is extracted, even when alum is present in so large a proportion; so far from it, that the aqueous infusion of this bread produced an immediate precipitate with a solution of alum, becoming abundant on gently warming the mixture, and rendering it impossible that alum should exist in the solution; so that this process of maceration in water only is entirely fallacious, and any sample of bread thus examined will give a precipitate with ammonia; but this precipitate consists only of phosphate of lime and phosphate of magnesia and ammonia, the extraction of which, by water only, appears somewhat remarkable, the acidity of the liquid being insufficient to account for their solution. The removal of these phosphates by water appears to be nearly complete, while the retention of alumina and phosphates of iron and manganese is no less entire.

The quantity of alkaline phosphates present in the ash, renders it highly probable that the alumina is retained as phosphate, which would sufficiently account for its ready solubility in nitric acid, after strong ignition; at any rate, Kuhlman's method of extraction by nitric acid from the ash answers perfectly, the only objection being the length of time required for complete incineration of the bread, to obviate which, it may, after charring in a capsule of platinum, be deflagrated with nitrate of potash, a process which can be effected over a spirit lamp. On digesting the mass in water, the alumina is almost wholly found in solution in the carbonate of potash thus produced.

Nitrate of cobalt is of no use as a means of detecting alumina in the ash, since the phosphates present are capable of giving the same reaction with this reagent before the blowpipe.

Since alumina is thus obstinately retained by bread, it seemed probable that its mordant properties might serve for its summary detection. With this view, a proportion of pure bread was immersed, simultaneously with a piece known to contain alum, in a freshly prepared and dilute decoction of logwood, and set aside for some hours, when a distinct difference between the two pieces was perceptible both in intensity and in shade of colour, which was more evident on breaking the two pieces. The pure bread was simply stained superficially with the pale orange-red colour of the decoction, while the alum piece had acquired a purple dye, which had penetrated to some depth. A baker in whose bread alum had been detected, acknowledged the fact when accused of it, but stated that he only used 1 oz. for a bushel of flour, or 1 oz. to about nineteen quartern loaves, which amounts to 5·7 grains of alum per 1 lb. of bread. Dr. Normandy also states that no effect is produced in improving the appearance of the bread, if the quantity of alum be reduced below 1 in 906 of flour, or below 1 oz. per bushel; hence this may be taken as the minimum probably in which this ingredient would be added. A loaf was therefore prepared with this proportion of alum, and was found to give a perfectly satisfactory reaction with the decoction of logwood, a piece of pure bread having been immersed at the same time by way of comparison.

Sulphate of zinc was on one occasion detected in bread by Professor Bloxam, when he was led to suspect it, from observing that the ash had a yellow colour while hot, which disappeared on cooling. It is probable that with bread of pure wheat-flour, this phenomenon would not be observed, in consequence of the transformation of the sulphate into phosphate of zinc, by the alkaline phosphates present, there being no excess of alkali present to prevent such a combination. On one or two occasions, however, I have observed a strongly alkaline reaction of the ash, due in all probability to the addition of potatoes; in such a case only would such a phenomenon probably be observed.

Having on one or two occasions detected small quantities of copper in brown bread, and finding it left in the bread after digestion of the latter in water, I wished to try whether sulphate of copper was in the same predicament as alum, and if so, whether ferrocyanide of potassium was capable of detecting its presence, as it is stated to do, by merely moistening the bread with its solution. A loaf was, therefore, prepared with the addition of this salt, in proportion of 10 grains to the pound; it was macerated in successive portions of water, in which very little copper was found to be dissolved, yet the residue from which all soluble matters had been abstracted acquired a decided reddish tint when treated with ferrocyanide of potassium, which was found to produce a more marked effect than ammonia or hydrosulphate of ammonia. Bread thus adulterated becomes, equally with alumed bread, strongly dyed by an infusion of logwood; so that this test, though alone incapable of distinguishing between the two, would at least indicate that something was wrong. In applying this test, the solution should be freshly prepared and diluted considerably; the pieces of bread should likewise be allowed to float in the liquid for about twelve hours, the effect being more marked than when they are entirely immersed so as to exclude the air. It is possible that unfermented bread might occasionally give a fallacious

indication, if the carbonate of soda were not wholly neutralised by the hydrochloric acid, added for the purpose by the baker. As, however, the alkali would pass into the solution, it seems probable that the latter would likewise be simultaneously affected, and the alkaline reaction of the bread would explain the phenomenon. The only unfermented bread thus examined became unmistakeably dyed; the bread, however, had a feebly acid reaction, and was found to contain abundance of alum.

Before concluding, it may be well to remark that it is difficult to judge of the quantity of alumina present, merely by observing its bulk and appearance on precipitation, since its appearance varies much with its mode of precipitation. It probably appears most abundant when precipitated from its solution in potash by careful neutralisation of the latter with a diluted acid, or by the addition of chloride of ammonium and gentle warming; if, however, the latter be boiled, or the precipitation be effected by addition of ammonia to its acid solution, the alumina is far more transparent, and in a hasty examination might even be overlooked, when present in small quantity. The decoction of logwood should also be made with water containing carbonate of lime such as that ordinarily supplied in London; for with a decoction of logwood in distilled water the differences of colour are far less marked.—*From Report Relative to the Grievances of the Journeymen Bakers.*

Transformation of Aldehydes and Acetones into Alcohols, by M. C. Friedel.

Some time ago M. Wurtz informed the Academy (*Comptes-Rendus*, February 10, 1862) that he had succeeded in changing oxide of ethylene into alcohol by the action of nascent hydrogen, such as is disengaged by the contact of water with amalgam of sodium. This remarkable reaction seemed equally applicable to aldehydes, enabling us to reascend to alcohols by a transformation the inverse of that which furnishes an aldehyde in starting from an alcohol. By making hydrogen, produced from a solution of zinc in weak sulphuric acid, act on vinic aldehyde, M. Wurtz invariably obtained negative results; and it seems there is no more hope of success in employing the amalgam of sodium, since the soda which should be formed during the reaction has the property of resinifying the aldehyde.

Hydide of benzoyle not being liable to modification in the same way by soda, I thought that the transformation, which seemed impossible with vinic aldehyde, would perhaps take place with this body. This, in fact, is the case. If amalgam of sodium is put in contact with a mixture of hydide of benzoyle and water, the supernatant layer, after a few hours, will only partially combine with bisulphite of soda. After leaving the product for some time in contact with this reagent, and frequently shaking the mixture, water then being added, the bisulphite of benzoyle, sodium, is dissolved, leaving an oily liquid, which can be decanted by means of a separating funnel. This liquid, whose odour differs from that of essence of bitter almonds, boils at 203°, and almost entirely distils away before 210°. Dried with the aid of a fragment of baryta, and twice distilled, it has the composition of benzoic alcohol, $C_7H_8O_2$.

As in the case of oxide of ethylene, two atoms of hydrogen go to a molecule of benzoic aldehyde to form the corresponding alcohol.

This reaction may be used with advantage in the preparation of benzoic alcohol. It can also be produced in an acid liquid. But the amalgam of sodium cannot be replaced by zinc, hydide of benzoyle having the singular property of hindering the solution of zinc in sulphuric acid. The metal becomes covered with large bubbles of hydrogen, but the disengagement of gas is hardly appreciable, and after several weeks the zinc wires, though corroded, were still entire in a strongly acid liquid. At the same time, benzoic acid is formed by the action of the air on benzoic aldehyde.

Since this experiment, M. Wurtz has found that vinic aldehyde, though partially resinified by the action of the soda, gives rise nevertheless to a notable proportion of alcohol when put in contact with amalgam of sodium in presence of water (*Comptes-Rendus*, April 28, 1862).

The reaction may, then, be considered as common to all aldehydes, or, at least, to those of the series $C_nH_{2n}O$, and $C_nH_{2n-6}O$. This also is the result of an experiment made on hydide of valeryle. The product of the reaction having been treated by sulphuric acid, and the mixture saturated by carbonate of baryta, we get amysulphate of baryta crystals, containing 30·84 per cent of barium (theoretically, 31·20). Consequently, it was formed of amylic alcohol.

The fact of the fixation of hydrogen on aldehydes being thus established, it became interesting to find out whether acetones, in many of their properties so similar to aldehydes, were not susceptible of hydrogenisation in the same manner, furnishing either a mixed ether or an alcohol:—

$$C_3H_6O + H_2 = \left.\begin{matrix} C_2H_5 \\ CH_3 \end{matrix}\right\} O = \left.\begin{matrix} C_3H_7 \\ H \end{matrix}\right\} O.$$

Acetone. Mixed ether. Alcohol.

The facts support the second hypothesis.

When the amalgam of sodium has reacted during several days on a mixture of acetone and water, a slight layer appears on the surface, which is increased by the addition to the watery liquid of a certain quantity of carbonate of potash. This layer decanted, dehydrated by means of carbonate of potash, and distilled, begins to boil about 75°, or sometimes 80°, if the reaction has been sufficiently prolonged. A large portion passes over between 80° and 90°, much less between 90° and 100°, and beyond this point, the thermometer rising rapidly to 175°, a considerable quantity of a viscous liquid remains.

The product, which passed over between 80° and 90°, consisted of a mixture of acetone, water, and an alcohol having the composition of propylic alcohol. In fact, by dissolving iodine in it and adding phosphorus, as in preparing hydroiodic ethers, an iodide is obtained, boiling between 90° and 95°, and with the composition of iodide of propyle.

This iodide reacts easily on acetate of silver, yielding iodide of silver and an ether boiling at from 90° to 93°, and giving on analysis this formula—

$$\left.\begin{matrix} C_2H_3O \\ C_3H_7 \end{matrix}\right\} O.$$

The same ether has been obtained by distilling the product boiling between 80° and 90° with a mixture of acetate of potash and sulphuric acid, or by heating the same product with acetic acid for several hours in a closed vessel, and at 130° or 140°.

Butyric ether has also been prepared by the direct action of butyric acid at 130° or 140°. The oily liquid produced had the characteristic odour of butyric ethers, boiling at between 124° and 130°, and its composition corresponded to the formula

$$\left.\begin{matrix} C_4H_7O \\ C_3H_7 \end{matrix}\right\} O.$$

As to the alcohol itself, it can be regenerated by decomposing, by potash, the acetate obtained by one of the processes to be pointed out. But a simpler method of isolating it is to shake up the liquid boiling between 80° and 90° with a concentrated solution of bisulphite of soda, and leaving them a long time in contact. The excess of bisulphite being separated by decantation, and the supernatant liquid holding in suspension the crystallised combination of bisulphite and acetone, the mixture is distilled *in vacuo*. Distillation takes place at a very low temperature, so as to prevent the combination of acetone and bisulphite from decomposing. The liquid passed into the receiver is then rectified several times over baryta. It almost invariably thickens between 84° and 86°. Several rectifications over baryta were insufficient to dehydrate it, and to get rid of all the water it is necessary to make sodium react on a portion of the liquid, and then to distil the rest on the crystallised product. After this further rectification, the alcohol distils between 86° and 88°, and on analysis gives this formula: C_3H_8O.

M. Berthelot wished to compare this product with the propylic alcohol he obtained by means of propylene gas (*Chimie Organique fondée sur la Synthèse*, vol. i. p. 114). He found that the alcohol obtained from acetone, like his, possessed the peculiar property of dissolving when cold in a solution of chloride of calcium of a certain degree of concentration, and of separating from it when hot. Treated by sulphuric acid, it furnished a gas having the odour of propylene, and absorbable by sulphuric acid.

From these facts it seems that the conclusion may be drawn that the product of the reaction of nascent hydrogen on acetone is propylic alcohol. However, since M. Cannizzaro has shown* that, in the aromatic series, the reaction of potash on hydrocyanic ethers furnishes isomeric products, but not identical with the superior homologues of bodies of the series from which he started, it is doubly necessary to be reserved in our conclusions on the passage of alcohol to one of its superior homologues by the intermediation of acid and acetone. Having to identify the alcohol derived from acetone with the true homologue of ordinary alcohol, I propose to submit this product to careful study.†

The product, boiling between 175° and 185°, is identical with the body obtained by M. Fittig from the reaction of sodium on acetone, and called *pinakone* by M. Staedeler, who regards it as a hydrate of the body $C_6H_{12}O$ derived from acetone by doubling and deoxygenating. It is, however, singular that a hydrate should boil without decomposing at 180°, and the formation of the body $C_6H_{14}O_2$ may be accounted for by supposing that only one atom of hydrogen passes to a molecule of acetone, thus forming a sort of monoatomic radical capable of combining with itself.

The following numbers result from the analyses:—

	I. (180° to 190°).	II. (175° to 180°).	Theory. ($C_6H_{14}O_2$).
C . .	61·27	60·73	61·01
H . .	11·78	12·09	11·86

The body $C_6H_{14}O_2$ seemed in several reactions to behave like a glycol. Gaseous hydrochloric acid transformed it when cold into a chlorinated liquid, decomposing by distillation with disengagement of hydrochloric acid, and yielding, by the action of potash, an oil with the odour of both ether and camphor. This oil thickens between 110° and 120°, its composition nearly corresponding to the formula $C_6H_{12}O$. I ought, however, to state that I have not yet succeeded in combining pinakone with two molecules of acetic acid, and so changing it into a diacetate.—*Comptes-Rendus*, lv. 54.

* *Comptes-Rendus*, June 16, 1862.

† This labour will be much lessened by the facility of now obtained acetone. Considerable quantities of this body are produced in the manufacture of aniline; and to the kindness of M. Coblentz, chemist at M. Collins', of the Briche-Saint-Denis, I owe part of that used in my experiments.

TECHNICAL CHEMISTRY.

*The American Oil Wells.**

A NEW branch of national industry has sprung up within the past two years, which promises to become both great and profitable,—we mean that of our native petroleum or rock oil. The export trade in this substance has already attained to vast dimensions. From the 1st of January last to the 23rd of June, no less than 2,961,317 gallons were exported from New York; 1,095,826 from Philadelphia; 190,512 from Boston; and 36,530 from Baltimore; making a total of 4,284,185 gallons. These native oils were forwarded to almost every country on the face of the globe; but England is our best single customer, as about two millions of gallons were sent to British ports. One merchant in Liverpool, who has imported largely, states that Great Britain alone can absorb one million barrels (42,000,000 gallons) per annum. When we reflect that this business is but in its infancy, the large quantity which has already been exported is perfectly surprising. It is believed that the United States and Canada possess natural supplies of petroleum to furnish the rest of the world, for ages to come, with sufficient quantities of oil to yield all the artificial light required, and perhaps much of the fuel also, as it can, and will, undoubtedly, yet be much used for the latter purpose.

The petroleum region embraces a vast extent of our continent. It is known to extend from the southern extremity of the Ohio Valley north to the Georgian Bay, in Canada West, and from the Alleghanies east, in Pennsylvania, to the western limits of the bituminous coal-fields. It has been found in Virginia, Maryland, Pennsylvania, New York, Ohio, Michigan, Kentucky, Tennessee, Kansas, Illinois, Texas, and in California. Oil wells, however, have been sunk in but a few localities as yet, and in some of these the original wells have been abandoned, on account of new and more copious supplies being obtained at less expense in other sections. In proceeding up the banks of the Ohio River, a derrick about twelve feet in height, and a small shanty beside it, with a rusty stove pipe stuck in its roof, is occasionally noticed. These are deserted pumping oil wells, and at Smith's Ferry, about forty-one miles below Pittsburg, there is a whole cluster of such wells, all stopped but two. The pumping apparatus of each is very simple. It consists of a small horizontal engine, connected by its pitman to a crank, which gives motion to a vibrating wooden beam, one end of which is attached to the vertical pump-rod in the well, which thereby receives a reciprocating motion that operates the pump plunger and lifts the oil. A rude derrick, a rough shanty, a small steam-engine, a pump, a few barrels and tubs, constitute the apparatus and utensils required for operating any of these oil wells. Such wells may be seen on both sides of the Ohio and Alleghany rivers, and occasionally on some of the little islands. They were mostly sunk before the flowing, deep petroleum wells in the Oil Creek region,

* From the *Scientific American*.

Pa., were discovered. Bore anywhere adjacent to the Ohio river for a few hundred feet, and earth oil is reached. We have noticed a coat of this oil covering the surface of the river for a distance of seventy miles. When the sunbeams shine upon the ripples it reflects the prismatic hues in beautiful green, crimson, and orange. It no doubt assists to lubricate the bottoms of the quaint-looking flat boats which run on the Alleghany, Monongahela, and the Ohio rivers. The pumping wells are generally suspended at present because the oil cannot be raised from them by steam power so cheaply as it can be obtained from flowing wells. But the oil obtained from the pumping wells at Smith's Ferry is of no common quality. It is almost as clear as refined petroleum, and it can be burned in lamps exactly as it is raised from the well. We have seen a mixture of one-half of this oil and an equal quantity of crude petroleum burn very well in a lamp. It resembled common whale oil. It is heavier than the refined petroleum, and is safe to carry and use. Only a few barrels per day, however, are obtained from single wells, or perhaps they might be operated with profit.

The petroleum wharf at Pittsburg, on the Alleghany River, is a greasy sight of an uncommon character. It is covered for half a mile with barrels of petroleum that have come down the river in boats from the Oil Creek region. A large number of flat boats are also generally lying at the wharf, some of which are discharging their green oily cargoes. These vessels are queer looking structures, being simply large boxes made of plank, and divided into cells forming tanks, which are made as tight as practicable. They are filled at the oil wells, then closed, and about from twelve to twenty of them are formed into a fleet and floated down the Alleghany River. Some boats carry the petroleum in barrels, but a large number are simply floating oil boxes. This part of Pittsburgh is redolent with the exquisite odour of Pennsylvanian subterranean Eau de Cologne. Refined petroleum may be obtained in Pittsburgh in large quantities for sixteen cents and upward per gallon. This burning fluid affords the cheapest known artificial light, and its use has spread from Maine to California, and it is now almost exclusively burned away up in the Lake Superior regions. While it can be obtained at such low prices, it will be used as an agent of artificial illumination, to the exclusion of all the more expensive agents of light, with the exception of coal gas.

(To be continued.)

On the Metallurgy of Platinum, by MM. H. SAINTE-CLAIRE DEVILLE *and* H. DEBRAY.

THE manufacture and uses of platinum are interesting in the highest degree to chemists, especially to theoretical chemists, who in their analytical operations so frequently make use of the remarkable properties of this precious metal. We therefore ask permission to present some observations and experiments we have recently made to complete the new system of metallurgic treatment we published some years ago in the French scientific serials.*

One of us has had an opportunity of witnessing our processes applied with great success by a clever English manufacturer, Mr. Matthey, of London. An ingot of platinum of 100 kilogrammes was melted in a quick lime furnace with lighting gas and oxygen. Under the influence of these powerful agents the mass became so liquid that it filled exactly with metal every part of the mould, and reproduced all its imperfections with unexpected precision.

The experiment occupied four hours; but as it took about half this time to heat the furnace itself, four hours, short time as it is for such an operation, may be considered as the maximum.

The aspect of this glowing liquid mass was a sight not easily to be forgotten. For this large operation, Mr. Matthey used the gasometer for melting ingots of from 20 to 25 kilogrammes, for which he has daily occasion. It is a surprising fact that, having on this occasion for the first time replaced the manganese or sulphuric acid, usually used in the preparation of oxygen, by chlorate of potash, Mr. Matthey decomposed at one time, and without taking any precaution, 22 kilogrammes of it mixed with its weight of manganese. The gas was disengaged with prodigious rapidity; but there is really no danger of an explosion provided the tubes are sufficiently large to carry off the gas. There is even no sensible increase of pressure in the apparatus.

A new process for moulding platinum is now used, invented by M. Heraeus, manufacturer at Hanau, and applied with considerable success in London. M. Heraeus, by the advice of his illustrious master, M. Wöhler, has adopted for several years the processes we published on the treatment of platinum, which, in the hands of a clever manufacturer and an enlightened chemist, have undergone already, as we anticipated, simplification and improvement. M. Heraeus runs the platinum into moulds of forged iron, the use of which we had given up; but he obviates all the inconveniences arising from the fusibility of the iron by placing at the bottom of the mould a leaf of platinum 1 millimètre thick, which supports the first contact of the fused metal.

Owing to this precaution, the ingots are very perfect, entirely free from those blisters so often visible upon cast metals, from which platinum is no more exempt than the other metals when it has been carelessly moulded.

From observations made in England, it is found that the alembics used in the manufacture of concentrated sulphuric acid are much more durable when fabricated with the cast platinum which Mr. Matthey now exclusively employs for this purpose. The platinum united by Wollaston's process is porous, and frequently allows the hot acid to leak through. We ought, moreover, to warn the manufacturers of platinum that the sulphuric acid prepared with Peruvian nitrate of soda contains a little chlorine, which acts upon the gold solder of platinum alembics with remarkable facility. For this reason it is very desirable to substitute for the gold in these vessels platinum melted by our oxyhydrogen blowpipe, and spread over the surfaces, to be united by the autogenous soldering processes.

This process, utilised for some time in England, gives excellent results, and from the great difference in value between gold and platinum, effects considerable saving.

One of us has had the opportunity of seeing in the laboratory of Mr. Matthey some tubes cast by this process, and drawn out without defect; and in the laboratory of MM. Desmontis, Chapius, and Quennessen some experiments tried upon cast platinum which promise valuable results.

Unhappily for the development of the platinum manufacture, the enormous price of these alembics has driven the makers of sulphuric acid to substitute for them

* See *Annales de Chimie et de Physique*, 3rd Series, vol. lvi. p. 385, and vol. lxi. p. 5; *Annales des Mines*, 5th Series, vol. xvi. p. 1, and vol. xvii. p. 71.

vessels of lead glass. Seven-tenths of the concentrated acid are now made in England with glass vessels, of which the first cost and expense of repairs are scarcely equal to half the annual interest of the sum necessary to provide a large platinum distillation vessel. The improved apparatus we offer to manufacturers—an improvement already realised in England, as we can vouch—consists in an alembic capable of concentrating at least from two to four tons of acid every twenty-four hours, at a price, at most, but a fifth or a sixth of the apparatus actually in use. By this reduction in price we believe that the workers in platinum will preserve to this metal a market,—a reduction to the interest of all, to the interest of our laboratories, our chemical manufactories, and to the platinum makers themselves. The development of platinum manufactures depends also on the Russian Government, which was the first to offer liberal incentives to improve and develope it. From information furnished us by M. Jaunez, a distinguished engineer well acquainted with the Oural mines, the yield of platinum ores is easily capable of threefold increase were the sale of these ores freed from all trammels. It is impossible to say at present to what rate the metal itself might fall if extracted by the economical processes we have published. Nor can we foresee the purposes to which the metal may be advantageously applied, its excessive price hindering all trials. It is to be hoped that the Government of Russia, which on this point has shown a real love of progress, and has profited by the counsel of its most distinguished scientific men, will make an entire change in a manufacture from which science benefits so largely.

We have called the attention of manufacturers to the advantages accruing, in some instances, from the use of iridium and platinum alloys, particularly of the natural alloy obtained by the direct fusion of the ores in an oxidising atmosphere. To facilitate the introduction of iridium into platinum, we have tried to find an economical way of extracting, by Wollaston's process, pure iridium from the residuums of platinum manufactures, residuums existing in large quantities in all the great factories of Europe. We have had recourse to the method of attacking by baryta, and in the interest of manufacturers we ask permission to describe summarily the operations. We took :—

Osmide of iridium, or residue† .	100 parts
Nitrate of baryta	100 ,,
Baryta	200 ,,

After being pulverised and well blended, the mixture is put into an earthen crucible and made red hot. The black matter and fritt resulting from this calcination is pulverised anew, and is put by small portions into cold water until the mass is well moistened. Nitric acid is carefully added to it, and the mixture is heated in a sand bath, either before a good chimney to carry off the osmic acid vapours which arise, or in a distilling apparatus; if it is wished to collect them, they can be fixed by caustic ammonia. When all osmic odour has disappeared, and enough nitric acid has been added to make the mass perfectly liquid, pour into the liquid a very small quantity of hydrochloric acid until the whole becomes of a yellowish red colour. Heat again; then pour into a funnel stopped up with gun-cotton, or into a sugar mould. The liquid, which flows slowly, contains chlorides of platinum, iridium, rhodium, and salts, with common metal bases. But the nitrate of baryta, being insoluble in liquid acids, remains on the funnel impregnated only with metallic chlorides. Displace these with a little pure water, as in the sugar refining process, and pure nitrate of baryta remains, not being carried away in any appreciable quantity with the dark thick liquid flowing through the funnel. We thus obtain:—

Nitrate of baryta	474 parts

This nitrate of baryta, which contains a little unattacked substance, serves for a fresh operation.

As to the liquid containing the precious metals, a few drops of sulphuric acid will free it from all trace of baryta, and then it is to be treated by the processes described in our memoir to which we refer.

In this way we have obtained, with three specimens of platinum prepared by precipitation by means of iron :—

	I.	II.	III.
Iridium with platinum . . .	33·1	38·7	52·9
Rhodium	20·0	5·9	8·1
Palladium	0·2	—	—
Osmium, common metals, and loss .	46·7	55·4	39·0
	100·0	100·0	100·0

In the first of these operations the amount of unattacked matter was 0·15 per cent.; in the second, 0·2 per cent.; in the third it was imperceptible. These figures annul M. Claus's objection that, in our analytical process founded on the same method, the rhodium was not entirely attacked by the baryta.

Mr. Matthey has modified this method by replacing the baryta, which we used to diminish the fusibility of the mixture, and which is very expensive in England, by nitrate of baryta itself, which is very cheap.—*Comptes-Rendus*, liv. 1139.

† These residuums were kindly lent us by Mr. Matthey, whom we take this opportunity of thanking for the intelligent and disinterested assistance he has in many instances afforded us.

PHARMACY, TOXICOLOGY, &c.

On the Calcination of Magnesia and the Means of Testing its Purity, by M. Amédée Vée.

Calcination of magnesia is an operation so simple, that at first sight it is not easy to comprehend how it can be made the subject of fresh observations, or how it can, in any case, fail to succeed. It is, however, constantly made evident that this is not the case, and that commercial magnesia, without speaking of its impurities, which have lately been much insisted upon, is far from possessing the physical properties which ought to pertain to it; it is dense, granular, very slightly attackable by diluted acids, and is with difficulty held in suspension in water. No way of avoiding these defects has hitherto been known except by preparing very small quantities at a time, and by stirring the carbonate with an iron spoon during calcination, as advised in the Codex. These plans cannot be adopted in wholesale manufacture, and there are now large *special factories* for the calcination of magnesia. A long time is necessarily taken up in calcining large quantities of carbonate, because the heat penetrates with difficulty to the centre of the mass, the periphery of which during the operation undergoes the action of a very high temperature; the heat, in fact, must be very great, for, in order to make as much use of the crucible as possible, the carbonate is heaped up, and thus forms an obstacle to the escape of the gases. With the help of my brother, M. L. Vée, civil engineer, I have succeeded in overcoming these difficulties, by constructing a furnace wherein the carbonate of magnesia, spread in a layer, not thicker than seven centimètres, is submitted to the action of the degree of heat strictly neces-

sary to decompose it. I will briefly describe the principal features of the apparatus.

It consists of a furnace and two retorts. There is no peculiarity in the construction of the furnace. The retorts are of cast iron, in shape rectangular; their height is only 10 centimètres, their breadth 60, their depth 70. The opening, occupying the whole of one of their smaller sides, is shut by means of a cast iron slab, fitting in a groove, and held in place by collars. The retorts are placed one above another, opening on one of the sides of the furnace, which are perpendicular to that in which the furnace-door is situated.

The direct action of the fire is on the lower retort; the product of the combustion passes round the back of it to reach and heat its upper surface, and the lower part of the other retort, round which it also passes before escaping up the chimney. The result of this arrangement is, that the lower retort becomes red hot, and the bottom of the upper retort somewhat less so. The decomposition begins in the upper retort, and is finished in the lower.

The carbonate must not be directly introduced into the retorts; fearing, but, as experience has shown me, without reason, to let the iron come into contact with the magnesia, I decided upon employing earthen cases, notwithstanding their weight, their fragility, and the length of time required to heat them, when it occurred to me to heat a fragment of sheet iron with magnesia, in a platinum crucible. I found that when not left too long in contact or at too high a temperature, the product was white, and not perceptibly more ferruginous than the carbonate which furnished it. So that I had sheet iron cases made in which to put the carbonate to be introduced into the retorts. The use of sheet iron is, however, not without its inconveniences; it becomes covered with a coat of oxide, which generally detaches itself in lamels, which require to be sifted from the magnesia. Occasionally this oxide is pulverent, but it does not mingle with the mass if care is taken to leave a small layer of magnesia in the case to protect the rest in the following operations; the heat puts the cases out of shape, and thin sheet iron must be used, that there may be no difficulty in removing the cases in and out of the furnace. These defects are compensated by the lightness of the case, the little space it occupies, and the facility with which it is heated and cooled.

To produce complete decomposition the carbonate should remain 45 minutes in each retort. Thus, every three-quarters of an hour a case of magnesia is taken from the lower retort, and immediately replaced by a case of partially decomposed carbonate from the upper retort, into which a fresh case of carbonate is then introduced. The operation is continuous and the consumption of fuel small, because it is never necessary to cool the furnace.

Prepared in this way, magnesia is as light as it is hydrocarbonate. It combines easily with water, and dissolves immediately in diluted acids.

In the course of my analyses, I have had occasion to examine a great number of samples of magnesia, derived from various sources, and I have never yet found a single specimen of magnesia or carbonate completely free from lime, neither have I found one containing a sufficient quantity to offer any inconvenience. I cannot say that the admixture with a considerable quantity of lime can never be the case; but I think it would be quite exceptional, perhaps because attention has been called to this point by recent publications. In this analysis, I have always adopted the following plan, which I will briefly describe; for though there is nothing absolutely new in it, yet this analytical method seems to me to give all the information necessary for appreciating any sample of magnesia by the aid of reagents to be found in every chemist's shop, without exacting any special skill like that required in an analysis by the bichloride of mercury. Weigh 1 gramme of magnesia, put it in a tared vessel, and dissolve it with a little diluted sulphuric acid; the solution should take place instantaneously, leaving no perceptible residuum. Then add 100 grammes of the solution to some water; shake it, and divide into two equal parts. With one portion mix 50 grammes of commercial spirits of wine, which precipitates the sulphate of lime; directly if there is much of it, in a few minutes if it exists in small proportion. Supersaturate the other half of the solution with ammonia; if the specimen contains any alumina this will be deposited coloured by oxide of iron; this coloration often fails, but the flakes of alumina almost always assume a dark green colour by the addition of a few drops of soluble sulphide.—*Répertoire de Chimie pure et Appliquée.*

NOTICES OF BOOKS.

Report addressed to Her Majesty's Principal Secretary of State for the Home Department, relative to the Grievances complained of by the Journeymen Bakers; with Appendix of Evidence. 1862.

The grievances complained of by the journeymen bakers would appear to be a proper subject for the philanthropist and the sanitarian, while many of the remedies proposed for them in this Report must be reserved for the consideration of the political economist. There are some things, however, in the Report of which a chemist may justly take cognizance; for, somehow or other, the adulteration of bread, which people are apt to consider a general public grievance, has got mixed up with the special grievances of the journeymen bakers; and, as a remedy for all these grievances, the universal adoption of aërated bread naturally occurred to the mind of Dr. Dauglish. We shall not do more than take a rapid review of the system of adulteration as detailed in this report, and the measures which practical men suggest for putting an end to it.

Bad as the adulteration is now, it is almost a satisfaction to know that it *might perhaps* at one time have been worse. We say *perhaps* because without a sample before us it is hard to credit Mr. Francis Crisp, when he told the Committee of the House of Commons in 1818 that at that time "the ingredients used to adulterate bread were alum, pearlash, soap of a particular description which creates a strong fermentation, and whitens bad flour; and also *stone flour*, which is made from Derbyshire stone, of which he produced a sample found in the possession of a baker at Deptford." The most imaginative of recent analysts and witnesses has not discovered soap in bread, although "stone flour," if that means sulphate of lime, and chalk have been found by Mr. Mitchell to be employed to give bulk to flour, and carbonate of magnesia, chalk and clay have been discovered in flour by Dr. Normandy. Sulphate of lime and bone-dust have also been found in flour by Dr. Bingley, but, generally speaking, the only mineral adulterant used either by the baker or miller is alum.

We shall not stop to discuss the question whether the use of alum should or should not be looked on as an adulteration, or whether its use is or is not prejudicial. There is no doubt the use is very general; probably more than half the bakers in London employ more or less of it. As to the quantity used the chemical evidence varies considerably, and it is to be noticed in this report that none of the bakers volunteered a statement of the amount they

employed. Mr. Tremenheere quotes from the evidence given before the Adulteration Committee of 1856, the statements of several chemists of the quantities they had discovered on analysis. Dr. Normandy found often from 25 to 30 grains of alum in the 4-lb. loaf, but more frequently smaller quantities. Dr. Challice found 12 oz. to 140 2-lb. loaves as a minimum. Mr. Rodgers found from 8 oz. to 2 lb. to 116 loaves, size not stated. Mr. Bastick found generally from 1 lb. to 3 lb., or 4 lb. per 100 loaves, size not given. Dr. Hassall's results are condensed in the following not too intelligible sentence:—"The quantities per 4-lb. loaf found by Dr. Hassall, and published in the *Lancet* of 15th February last, show in many instances a much higher per-centage than those above given; 12 out of 17 cases analysed showing a proportion of from 17 to upwards of 30 grains per sack of flour made into 92 4-lb. loaves." The author, of course, means, as we see by a reference to Dr. Hassall's table, from 17 to 30 grains per 4-lb. loaf. Dr. Septimus Gibbon was more successful still. He analysed 32 samples of bread, and found alum in the whole of them, to the extent of from 30 to 60 grains per 4-lb. loaf.

As to the effects of alum, the author quotes the following as the testimony of experienced medical men. Dr. Carpenter said before the Committee on the Adulteration of Food, "that alum in bread is extremely injurious." Dr. Normandy stated that he who eats aluminized bread "not only loses the nourishment of good bread, but gets also an enfeebled digestion, and therefore inferior power of performing work, and a debased condition of health." Mr. Rodgers stated, "that even the smallest quantity is injurious. A person eating a pound of bread a-day would eat eight grains of alum with the bread containing the minimum quantity. Great gastric irritation would be produced. The minimum of eight grains in the four-pound loaf would have a pernicious effect on delicate persons." To the same effect is the opinion of Drs. R. D. Thompson and Challice; and, as we write, it is a matter of wonder to us that we are alive and in tolerable health considering the amount of this most pernicious substance we must have swallowed in the course of our existence. Remembering, however, that most of the authorities quoted above are not practising physicians, we think there may possibly be room to doubt the accuracy of their conclusions.

Dr. Gibbon's evidence is curious. Admitting that the alum enters into chemical composition with the gluten of the flour, he confesses that its effects are less injurious than when taken alone. But still he believes that this impurity in bread is "the chief cause of the frequent constipation, headaches, liver derangements, &c., of those who are dependent on bakers for their bread;" that is, of 99 out of every 100 of those who suffer from the above-named complaints.

As we have said, we do not intend to discuss this question, and perhaps it would be well if mere chemists would refrain altogether from expressing an opinion on the matter. We shall only allude to one part of the question which is raised in Dr. Gibbon's evidence. Does the alum, or only the alumina, enter into chemical composition with the gluten? and what are the effects of alumina or aluminate of gluten on the stomach and bowels? The former question has an important bearing on the detection of alum in bread. It is stated by Mr. Hadow, in a Paper communicated to this Report (which we print at length in another part), and it is a fact well known to those who have experimented on the matter, that the alumina can never be dissolved out of the bread by macerating it in water, but that sulphuric acid is always found in the solution in too great a quantity to be obtained from the common salt or from the ordinary constituents of flour. The alumina is only found after incineration.

This fact, too, of the combination of the alumina with the gluten, would seem to be an objection to Mr. Hadow's mordanting test, since, if it be already combined with an organic substance, its power to fix a colouring matter must be greatly modified or altogether destroyed. The idea of this test occurred to ourselves some years ago, but after a series of experiments, we came to the conclusion that it was valueless. The results, however, of so accurate an experimenter as Mr. Hadow, may well be set against our own, and we shall be glad to hear the experience of other chemists with the test.

There is only one other novelty in the way of testing for alum given in this Report, and that is the suggestion of Dr. Gibbon, that "the important aid of the recent great invention of the spectroscope might perhaps be available for all cases where the metallic bases are present, as in the case of aluminium in bread." Either Dr. Gibbon or Mr. Tremenheere adds in a foot-note, by way of enforcing the suggestion, that the cost of the apparatus is only about 6*l.* 6*s.*; but perhaps they will both learn for the first time, that the spectrum of aluminium is by no means characteristic, and can only be seen by the aid of the induction coil or the electric light,—a circumstance that will materially increase the cost of the experiment to the public analyst. Here, for the present, we may leave this report, to which, however, we shall return again for other matters which may interest our readers in the triune capacity of chemists, householders, and bread-eaters.

NOTICES OF PATENTS.

1795. *Heating Water or other Fluids.* J. H. Butterworth, Rochdale. A communication. Dated July 17, 1861.

1796. *An Improved Mode of and Apparatus for Heating Air, or for Desiccating Wet or Moist Substances.* J. H. Butterworth, Rochdale. A communication. Dated July 17, 1861.

These inventions relate to the novel employment of a metal or alloy, fusible at a low temperature, for the purpose of absorbing heat imparted thereto by fire, and in applying the heat so obtained for the heating of water or other fluids, or in the drying of moist precipitates or products. The apparatus consists of a receptacle provided with an arrangement of internal tubes, similar to a multitubular boiler, around which the fusible metal is disposed, and the firing is so managed that the metal when once in a state of fusion may be kept melted by the consumption of a minimum of fuel. The water to be heated is passed through the internal tubes, where it may either be converted into steam, or simply raised in temperature to the degree required. In like manner air may be forced through the same tubes by the aid of a fan blast, and thence conducted into a desiccating chamber, where the substance to be dried is already laid out on shelves of perforated metal, or drawn slowly through the heated atmosphere upon metallic cloth carriers.

The object of the foregoing expedient is stated to be the economisation of fuel, but so far as the final result is concerned it cannot make any practical difference whether the firing be judiciously applied direct to the water or air in the ordinary manner, or whether a bath of fusible metal be employed as a medium for the transmission of heat. In either case the heat generated by the combustion of the fuel must eventually be taken up by the water or air, and the action is but moderated by the intervention of a large mass of fusible metal. Serious disadvantages are presented in the liability to corrosion induced by the long contact of fluid alloys with the iron receptacle and fittings, and the possibility also of strain being exerted by the unequal expansion and contraction of dissimilar metals.

1817. *Cast Steel.* R. Mushet, Coleford. Dated July 19, 1861.

This invention consists in adding tungsten or chromium

ores, any mixture of these, or any product obtained by their partial reduction, to scrap iron or steel, for the purpose of improving its quality by such alloy.

Mr. Mushet enumerates in his specification a great variety of processes, by any one of which the desired alloy can be formed; thus, not only may all kinds of pig, refined and pulverized, wrought and cast iron be employed, with or without manganese and carbon, but any ore or mixture of materials capable of yielding cast steel. With regard also to the sources of tungsten, the inventor claims the use of tungstic acid, native wolfram, or of any compound obtained from these by the reducing action of carbon; and in the case of chromium the employment either of the oxide, chrome-iron ore, or any product of its deoxidation.

The alloys of tungsten with iron and steel appear to be exceedingly hard, and to possess other valuable properties. Their manufacture on the large scale is attended with difficulties, which it is to be hoped the inventor will be able to surmount.

1819. *Obtaining Nitrous Acid Gas for Making Sulphuric Acid.* R. Laing and G. H. Cossins, Ince, near Wigan. Dated July 19, 1861.

For the production of nitrous acid the inventors use arsenious or arsenic acid to decompose the nitrate of soda or potash. If nitrate of soda be employed, they prefer to use the proportions of seven parts of the nitrate to five of arsenious, or six parts of arsenic acid. For seven parts of nitrate of potash four parts of arsenious acid are sufficient. The above decompositions are carried on in clay muffles or retorts so placed as to be heated by the ovens or furnaces in which the pyrites is burnt, the gas being conducted from the retort through a small bent tube in the direction of the draught. The object of using such close vessel and tube is to protect the mixture from the action of sulphurous acid gas by which it is surrounded. A second claim refers to the use of chrome-iron ore for effecting the decomposition of the nitrate of potash or soda; the proportions to be employed being regulated by the amount of oxide of chromium contained in the ore, and the operation being conducted by preference in a small reverberatory furnace detached from the pyrites ovens.

The latter of these suggestions offers peculiar facilities for carrying out at the same time two processes which are occasionally associated in chemical works, viz., the manufacture of bichromate of potash and sulphuric acid.

Grants of Provisional Protection for Six Months.

2075. William Clark, Chancery Lane, London, "An improved pomade or balsam."—A communication from Mr. Achille Barborin, Boulevart St. Martin, Paris.—Petition recorded July 21, 1862.

2314. John Cimeg, Great James Street, Bedford Row, London, "Improvements in depositing silver and other metals on fabrics and other materials."

2326. John Garrett Tongue, Southampton Buildings, Chancery Lane, London, "Improvements in processes and apparatus for extracting the natural wax or fatty matters from wool hair, or other animal or vegetable substances containing the same, and in the application thereof to various useful purposes."—A communication from Augustin Evrard, Paris.

2330. William Hodgson Hutchinson, Newton Heath, near Manchester, "Improvements in the manufacture of ammonia and the prussiates of potash or soda, and in apparatus employed in such manufactures."

2335. Johann Carl Schemmann, Hamburg, "Improvements in the manufacture of steel."

2341. Sandiforth Featherstone Griffin, New Adelphi Chambers, London, "Improvements in apparatus to be used in the distillation of petroleum or any oleaginous, resinous, or alcoholic bodies."

2346. James Mackay, Glasgow, Lanarkshire, N.B., "Improvements in the manufacture of soap powder."

2357. Martin Kenneth Angelo, Gloucester Place, Portman Square, London, "Improvements in apparatus used in the manufactare of shellac."

2360. William Edward Newton, Chancery Lane, London, "Improvements in the mode of and apparatus for treating fermentable substances for brewing and distilling."—A communication from Friedrich Wilhelm Hoepfner, Linienstrasse, Berlin, Prussia.—Petitions recorded August 23, 1862.

2380. William Edward Newton, Chancery Lane, London, "An improved method of producing light for the various purposes of artificial illumination."—A communication from George Hand Smith, Rochester, Monroe, New York, U.S.

Notices to Proceed.

1222. Lachlan McLachlan, Manchester, "Improvements in governing or regulating light used for taking photographic portraits and other photographic pictures, part of which improvements is also applicable to lighting picture galleries."

1271. James Maiden, Waterloo, near Ashton-under-Lyne, Lancashire, "Improvements in safety lamps."

1347. Paul Chenaillier, Paris, "Improvements in apparatus for concentrating liquids or for condensing alcoholic or other vapours."

1364. Nicholas Wood, Hetton Hall, Durham, and Joseph Stockley, Newcastle-on-Tyne, Northumberland, "Improvements in apparatus for grinding, smoothing, and polishing plate glass."

1940. William Mattieu Williams, Handsworth, Staffordshire, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons."—Petition recorded July 3, 1862.

2075.—William Clark, Chancery Lane, London, "An improved pomade or balsam."—A communication from Achille Barborin, Boulevart St. Martin, Paris.—Petition recorded July 21, 1862.

2221. Francis Montgomery Jennings, Cork, Ireland, "A composition for coating ships' bottoms to prevent fouling."—Petition recorded August 8, 1862.

CORRESPONDENCE.

Amorphous Phosphorus.

To the Editor of the Chemical News.

Sir,—Allow me to draw the attention of "Constant Reader"—to whom you replied in your last Number—to Dr. Wilson's remarks on amorphous phosphorus in his work entitled, "Religio Chemici," p. 126 *et seq.*; and in confirmation of what he states, I may say that we manipulate with large quantities in our manufactory, and not the slightest inconvenience of any kind arises from its use. This is an interesting fact, especially to those who are acquainted with the direful effects of common phosphorus on those engaged in making ordinary lucifers.

I am, &c.

Wilberforce Bryant.

Patent Safety Match Works, Fairfield, Bow, London, E.

On the Chemical Examination of Iron Samples.

To the Editor of the Chemical News.

Sir,—It was a pleasure to read Mr. Abel's excellent paper in your Journal of last week. There is one point, however, which is not very easily understood, and that is, why Mr. Abel should, in order to test for arsenic, dissolve the iron in hydrochloric acid. Surely the greater portion of the arsenic, if not the whole of it, would escape as arseniuretted hydrogen; and it is by no means desirable,

even when merely testing for an ingredient which exists in such small quantity, that any should be lost.

One might, however, readily imagine that dilute hydrochloric acid would act as Wöhler found dilute sulphuric acid did, and leave all the arsenic in the carbonaceous residue, none going off as arseniuretted hydrogen. But the paper does not say if the acid used was dilute. A method of estimating or testing for the metals precipitable by hydrosulphuric acid, practically the same as that given by Fresenius, I have found to answer exceedingly well. It is to dissolve the iron in nitro-hydrochloric acid, expel the nitric acid in the usual way, dilute largely, reduce with sulphurous acid, boil till all the sulphurous acid is driven off, saturate the liquid with hydrosulphuric acid, allow it to stand in a corked flask for some hours, upon which the metals (copper, arsenic, antimony, &c.) will precipitate, filter, expel the hydrosulphuric acid by heat, add a little sesquichloride of iron, and estimate the phosphorus in the usual way.—I am, &c. K. K.

Mandioca.

To the Editor of the Chemical News.

Sir,—In answer to a "Reader's" inquiry, I beg to enclose an extract from T. C. Archer's "Popular Economic Botany," page 79.—I am, &c.

Robert Oxland, Jun.

"Cassava, Mandioca, Farinha, or Farine de Manioc.—These also are preparations from the roots of the tapioca plant. Instead of washing the starch from the pulp, the pulp is dried upon hot metal plates, and afterwards roughly powdered; this rough powder, according to its fineness, is called by the names above mentioned. It is much used in the Brazils to make flat thin cakes, like the oaten cakes of Scotland, which are known as "cassava bread;" very large quantities of this preparation (mandioca flour) are imported and sent to the manufactories, to serve as a substitute for common starch. The Portuguese name Farinha is also often used in commerce to designate the varieties of mandioca meal."

Spectrum Analysis.

To the Editor of the Chemical News.

Sir,—Can any of your readers inform me whether such a thing exists as a "Manual," or even a comprehensive Paper, giving detailed instructions on the manipulation necessary in spectrum analysis? Also, whether for purposes of demonstration the electric light is indispensably necessary? and whether an ordinary spectrum can be obtained by the aid of the oxyhydrogen light?—I am, &c. F. B.

[We do not know of such a work as our correspondent inquires after. A sufficiently good spectrum for all ordinary lecture demonstrations can be obtained with the oxyhydrogen light.—Ed. C. N.]

MISCELLANEOUS.

The Jury Award for Thallium.—Pending those utterances of wisdom which the Council of the Society of Arts have invited from jurors and leading exhibitors with regard to the advisability of giving medals or other rewards of merit, a good deal of curious matter engages the talk of the Exhibition building. Dr. Lyon Playfair, in a preface to the second edition of his book of jurors' awards, is very careful to inform the public that, although several additions have been made to the original list of *décorês*, no single instance occurs of any new award having been made. The explanation is, that in copying from the papers sent in by the juries there was no time to refer to the minute-books for the verification of details. We question the validity of the grounds on which the Special Commissioner for Juries gives utterance to his singular boast, on behalf of those bodies, that they have determined not to award medals to exhibitors whom they have confessedly overlooked in haste. At any rate, some of the newly published awards, in the second edition, come very suspiciously after strong representations of injustice. One example may be cited. Mr. William Crookes, the discoverer of the new element, thallium, and the exhibitor of several of its compounds, was passed over by the jurors of Class 2; while M. Lamy, a Frenchman, who brought a specimen of thallium into the building about two months after it had opened, received the honour of a medal. Mr. Crookes had sent in his case, containing not only the compounds we have glanced at, but the element itself, a drawing of its spectrum, some minerals containing it, and full written descriptions of its chemical properties, before the opening of the Exhibition. However, as we have said, he was ignored in favour of his foreign rival—who, by the by, never pretended to have been the discoverer of thallium. On the contrary, in a paper read by M. Lamy before the Académie des Sciences, the honour is freely given to Mr. Crookes. Under these circumstances, our countryman appealed to the Commissioners of the International Exhibition, laying his case very strongly before them. He gets his medal for the "discovery," as appears by the second edition of the book of awards; and at the same time M. Lamy retains *his* medal for the "discovery" also. We confess our inability to understand this. One or other "discoverer" must have been first, and both cannot well be entitled to a medal. But what more especially strikes us in the aspect of this case is the difficulty of conceiving that the omission of the Englishman's name should have been the result of mere accident. Does the "minute-book" of Class 2, Section A, really and truly show that the jury gave two medals for the "discovery" of one object? Plainly speaking, we don't believe it. There is too glaring an evidence of the fact that, having been forced into an act of justice to Mr. Crookes, the jury shrank from the disagreeable task of officially withdrawing their countenance from M. Lamy, and so took the egregious course of complimenting each gentleman on being the original discoverer of a new field in science.—*Daily Telegraph*, September 15, 1862.

British Association for the Advancement of Science.—The arrangements for the forthcoming meeting of this Association at Cambridge are now approaching completion. The following is a programme of all that can at present be decided upon. The meeting (the thirty-second) will commence on Wednesday, October 1. President: the Rev Robert Willis, M.A., F.R.S., Jacksonian Professor of Natural and Experimental Philosophy, Cambridge. Vice-Presidents: the Very Rev. the Dean of Ely, D.D.; the Rev. W. Whewell, D.D., F.R.S., Master of Trinity College, Cambridge; the Rev. A. Sedgwick, M.A., F.R.S., Woodwardian Professor of Geology; G. B. Airy, Esq., M.A., F.R.S, Astronomer Royal; G. G. Stokes, Esq., M.A., F.R.S, Lucasian Professor of Mathematics; J. C. Adams, Esq., M A., F.R.S., Lowndeian Professor of Astronomy and Geometry, and President of the Cambridge Philosophical Society. General Secretary: W. Hopkins, Esq., M.A., F.R.S., St. Peter's College, Cambridge. Assistant General Secretary: John Phillips, Esq., M.A., LL.D., F.R.S., Professor of Geology, Oxford. Local Secretaries, C.C. Babington, Esq., M.A., F.R.S., Professor of Botany, Cambridge; G. D. Liveing, Esq., Professor of Chemistry, Cambridge; Rev. N. M. Ferrers, M.A.. Gonville and Caius College, Cambridge. Local Treasurer: Rev. W. M. Campion, B.D., Tutor of Queen's College, Cambridge. The Town Hall, which has been placed at the disposal of the Association by the Corporation, will be open as a reception-room on Monday, September 29, at ten a.m., and on the following days at eight a.m., for the issue of tickets to members, associates, and

ladies, and supplying general information as to lodgings, &c., to strangers on their arrival. Persons desirous of becoming members or associates are to make application in this room. The "journal," containing announcements of the arrangements for each day, will be laid on the table on Wednesday, October 1, and the following mornings, at eight a.m., for gratuitous distribution. The member's ticket contains a map of Cambridge, and particulars as to rooms appointed for sectional meetings. A branch post-office will be opened here, which will also be available for communication between members attending the meeting, and there is a telegraph-office in the same building. The General Committee will hold its first meeting in the Town Hall, on Wednesday, October 1, at one p.m., for the election of sectional officers, and the despatch of business usually brought before that body; and again, in the same room, on Monday, October 6, at three p.m., for the purpose of deciding on the place of meeting in 1863; and the concluding meeting on Wednesday, October 8, at one p.m., when the Report of the Committee of Recommendations will be received. The first General Meeting will be held in the Town Hall on Wednesday, October 1, at eight p.m., when William Fairbairn, Esq., LL.D., F.R.S., will resign the chair, and Professor Willis will assume the presidency, and deliver an address. The various sections will assemble in the rooms appointed for them, for the reading and discussion of reports and other communications on Thursday, Friday, Saturday, Monday, and Tuesday, October 2 to 7, at eleven a.m.

Silvering by Powdered Tin.—A quantity of pure tin is melted and poured into a box, which is then violently shaken; the metal assumes when cold the form of a very fine grey powder. This is sifted to separate any coarse particles, and is mixed with melted glue. When it is to be applied it should be reduced by the addition of water to the consistence of thin cream, and is laid on with a soft brush like paint. It appears when dry like a coat of grey water colour, but when it is gone over with an agate burnisher it exhibits a bright surface of polished tin. If the glue is too strong the burnisher has no effect, and if too weak the tin crumbles off under the burnisher. A coating of white or gold-coloured oil varnish or lacquer is immediately laid over it, according as it may be intended to imitate silvering or gilding. This kind of gilding is often used for covering wood, leather, iron, or other articles in constant wear. It is very ornamental.

Noxious Vapours.—The Report of the Lords Committee appointed to inquire into the injury resulting from noxious vapours evolved in certain manufacturing processes, has just been issued. The most important portion is the following:—"The Committee think that it would be most desirable that the laws respecting nuisances generally should be consolidated, and made uniform throughout the country; but, whether this be practicable or not, there are certain points on which amendment appears to them to be urgently required. They recommend that the provision of the Smoke Prevention Act respecting offensive trades should be made of universal application; that gases evolved in manufacturing processes from furnaces or chimneys should be placed on the same footing as smoke from furnaces; that full effect should be given to the 24 and 25 Vict., c. 77, s. 13; that medical inspectors, when appointed, should have the right of free access to all works productive of noxious vapours at all hours when such works are in operation; that the power, on the part of the defendant, of demurring to the jurisdiction of the magistrate, should be abolished; and if any appeal be allowed to the superior courts, they would be inclined to restrict it to cases in which the magistrate should certify that they involved questions of law fitting to be there heard and decided. While, however, the Committee think that the alterations they have suggested will be found adequate for the more ordinary nuisances, yet, looking to the very serious injury caused by alkali and other chemical works of a like description, to the great extent of those trades, and to the proved and admitted preventibility of any nuisance by proper precautions, they concur with the manufacturers engaged in those trades, that they ought to be dealt with by special legislation. They do not hesitate to express their opinion that the Legislature should not attempt to prescribe the specific process by which the nuisance should be prevented, but that a substantial penalty should attach to the escape of gas or vapour during the process of manufacture; that any person should be at liberty to sue for such penalty, and that it should be recoverable at quarter sessions, without appeal to the superior courts, except in cases in which the magistrate should certify that they involved questions of law fitting to be there heard and decided. But the Committee feel bound to record their opinion that, for the effectual suppression of this nuisance, it will be necessary that inspectors, properly qualified, should be appointed, who should at all times have free access to the works, with or without notice, so far as may be necessary for ascertaining that nuisance is effectually prevented, and who should be officially charged with the duty of enforcing the law; and, without desiring to imply any suspicion of the local authorities, they concur in the opinion expressed by more than one witness, that such inspectors, by whomsoever appointed and paid, should be wholly independent of all local control, and removed as far as possible from all local influence. The Committee have reason to believe that, in framing a measure on these principles, her Majesty's Government will have the cheerful co-operation of all the most respectable manufacturers engaged in the trades affected by it."

Seamless Copper Tubes.—Some of the seamless tubes made ostensibly from copper, appear to be formed of an alloy. This is the more probable because copper cannot readily be cast into the hollow ingots from which the tubes are to be drawn. Pure copper, in its melted state, has a pudding-like consistency, and when cast is likely to come out unsound. In alloying it, to increase its fluidity when melted, the metal is not only debased, but it loses much of its malleability. At a seamless tube works, near New York, pure copper is cast into sound tubular ingots by running the fluid metal into moulds revolving some 2000 turns a minute. The centrifugal force thus imparted to the metal condenses it upon the inner surface of the mould, and experience, in the use of the tubes thus cast, shows that perfect soundness is thereby attained. The refining furnace is set up close by the moulds, of which there are twenty, more or less, disposed radially around a central shaft, the axis of each mould lying horizontally. A large friction wheel on an upright shaft gives motion to all the moulds. A measured quantity of metal from the furnace is poured successively into the end of each mould, the result being a tubular ingot, of say 1ft. length, 4½in. in diameter, and having a beautiful smooth cylindrical hole of about 3in. bore throughout its length. When cold this ingot is heated and rolled upon a loose mandril, between four rollers so disposed as to embrace its entire circumference. After being thus rolled out to a length of 2ft. the process is repeated until the length is increased to 3ft. or 4ft. After annealing it it is then drawn successively through dies of gradually diminishing size until the tube has been brought to the required diameter and length. A single pass through a smoothing die completes the process. —*Engineer.*

ANSWERS TO CORRESPONDENTS.

K. K.—The account inserted in the CHEMICAL NEWS is the fullest which has hitherto been published.

A Tyro.—Your error lay in not adding a sufficient quantity of chloride of ammonium to the solution.

F. L.—The Secretary of the Society, at Burlington House, will give you every information on the subject.

Sulphur.—You will meet with no test more delicate than the nitroprusside of potassium.

THE CHEMICAL NEWS.

VOL. VI. No. 147.—September 27, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by FRANK H. STORER *and* CHARLES W. ELIOT.*

(*Continued from page* 146.)

5. Many chemists, among whom may be mentioned Vauquelin, Berzelius, Döbereiner, and Thomson, have tried the experiment of gently igniting the nitrate of chromic oxide, or, what amounts to the same thing, of evaporating to dryness nitric acid in contact with metallic chromium or hydrated chromic oxide, and moderately heating the residue. Some, like Berzelius,† have thought that they obtained in this way a definite oxide of chromium, intermediate between chromic oxide and chromic acid, and answering to the formula CrO_2; others, like Vauquelin,‡ have imagined that they obtained chromic acid by repeated evaporation of nitric acid with chromium, or have believed, with Thomson§ and Godon,‖ that a great part of the green oxide was converted into chromic acid; while others still have maintained, with Döbereiner,¶ that the chromate of chromic oxide was formed by the decomposition of the nitrate.

In order to a clear knowledge of the effect of evaporating nitric acid with chromic oxide, it is necessary in the first place to answer qualitatively the question,—Is chromic acid formed during the process? A mixture of nitric acid and hydrated chromic oxide was gently evaporated, first on a water bath, then upon a sand bath, and before the free nitric acid was completely driven off, a portion of the moist mass was treated with a solution of caustic potash; it partially dissolved with a yellow colour, and the solution gave the distinct blue of perchromic acid with peroxide of hydrogen. The rest of the evaporated residue was heated till it looked like a perfectly dry powder, but still retained the smell of nitric acid. In this condition a portion was treated with water, in which it slowly and partially dissolved, yielding a brownish yellow solution, which readily gave the blue of perchromic acid. A half of the remaining residue from the original evaporation was strongly heated in a porcelain dish on a sand bath, and then digested with water during four hours; the solution so obtained was decidedly yellow, and gave easily the blue of perchromic acid. The other half of the residue was heated on platinum foil, till the platinum was of a dull red colour in a darkened room, and was then soaked in water for thirty-six hours; the supernatant liquid was of a pale yellow colour, and gave a faint blue with peroxide of hydrogen. The same substance treated with caustic potash gave a yellow solution.

With this qualitative evidence of the formation of an abundance of chromic acid at a moderate temperature, which is not wholly destroyed even at incipient redness, we proceeded to the quantitative determination of the amount of chromic acid formed at the different stages of the process. A quantity of pure hydrated chromic oxide was treated in a porcelain dish with an excess of pure nitric acid, and evaporated on a water bath nearly to dryness; those parts of the substance which dried completely were moistened with nitric acid and again dried. The nitric acid could not be completely driven off on the water bath; though the larger part of the mass seemed dry, yet portions of it were still moist when the process was stopped, and it was far from being homogeneous. The brownish black substance imparted a strong yellow tinge to water, and dissolved with difficulty in dilute nitric acid, giving a brownish yellow solution. A portion of it, analysed by Rose's method, gave—

Cr_2O_3 = 64·85 per cent.
CrO_3 = 31·51 ,,
NO_5 and HO = 3·64 ,, (by diff.)

It was now necessary to prepare for analysis from the evaporated residue a series of homogeneous substances, each of which had been exposed to a little higher temperature than the preceding one, in order to exhibit the effect of different temperatures in the production of chromic acid. A portion (No. 1) of the evaporated residue was heated on a porcelain dish at a low temperature, with constant stirring, to complete dryness; a second portion (No. 2) was first thoroughly dried at the same temperature to which No. 1 had been exposed, and was then somewhat more strongly, but still very gently, heated for a few minutes, during which nitrous fumes escaped in abundance; in this manner each substance was dried at the highest temperature to which the preceding one had been exposed, and was then subjected to a little stronger heat during five or ten minutes; the last substance (No. 5) was heated as hot as was possible, while avoiding incipient redness. The chromic acid of each substance was determined by precipitating it with nitrate of the suboxide of mercury; the chromic oxide was also determined in two or three cases, but only to control the analyses. All five substances were soaked in water for five hours; pure nitric acid was then added in very small quantity, and, at the end of forty-four hours more, solution had been effected in each case. The colour of the dry powder was brownish black, that of the solutions brownish yellow. The per-centage of chromic acid in each substance was as follows:—

	CrO_3.
No. 1	25·18 per cent.
No. 2	26·09 ,,
No. 3	48·52 ,,
No. 4	55·49 ,,
No. 5	60·39 ,,

* Read before the American Academy of Arts and Sciences.
† Thomson's *Ann Phil.*, iii. 104 (1814), and Schweigger's *Journ. für Ch. u. Phys.*, xxii. 56.
‡ *Ann. de Chim.*, xxv. 201 (1798).
§ *Phil. Trans.*, 1827, Part i. p. 206.
‖ Rapport par MM. Berthollet et Vauquelin, *Ann. de Ch.*, liii. 224.
¶ Schweigger's *Journ. für Ch. u. Phys.*, xxii. 482 (1818).

It therefore appears that a variable amount of chromic oxide may be converted into chromic acid by evaporation with nitric acid, and that the quantity so changed increases with the increase of temperature till incipient redness is reached. If this mixture of chromic oxide, chromic acid, and nitric acid be exposed to a red heat, the nitric acid and the absorbed oxygen are driven off together, and nothing remains but insoluble chromic oxide. It is sufficiently clear from these results, that no definite compound can be formed during this evaporation of nitric acid in contact with chromic oxide; the result is simply an indeterminate mixture of chromic oxide and chromic acid. It may be remarked, in passing, that this mixture closely resembles in every external property the brownish black powder obtained by gently heating chromic oxide in contact with the air, a substance which, as we have seen, is also an indeterminate mixture of chromic oxide and chromic acid, containing, however, very much less chromic acid than the mixture just examined. Substance No. 5 of the preceding series, although anhydrous, yields chlorochromic acid with salt and sulphuric acid with the greatest facility, another indication that the true explanation of Krüger's not obtaining chlorochromic acid from his heated chromic oxide is to be found in the fact that it contains too small an amount of chromic acid to be exhibited by that somewhat coarse reaction.

6. Many distinguished chemists have observed the reactions and studied several of the substances which we have here described, and no treatment of the subject can be complete which does not embrace an abstract of their labours. We shall, therefore, relate as concisely as possible the history of the substance which has been variously called brown oxide of chromium, or chromate of chromic oxide, and review the discussion as to its composition, which has heretofore been brought to no satisfactory conclusion.

Vauquelin,** the discoverer of chromium, obtained what he thought to be a brownish-red oxide of chromium by several methods, the details of which it is unnecessary to describe; it will be enough to observe, that neither of his methods gave him a definite compound; they all gave rise to indeterminate mixtures of the bodies now known as chromic oxide and chromic acid. He proved that nitric acid, whether cold or boiling, cannot oxidise chromic oxide, but that the calcination of the nitrate of chromic oxide produced a substance whose aqueous solution was red; ammonia precipitated from this solution the green oxide, and the separated filtrate was yellow. His experiments led Vauquelin to the conclusion that there are two kinds of oxide of chromium, which differ only in the quantity of oxygen they contain.

Two errors, into which the reader of Vauquelin's papers might easily fall, demand notice. It might be inferred from some of his statements that the chromate of ammonia was a body readily decomposed by simple boiling with separation of the so-called brown oxide of chromium. We have found the chromate of ammonia to be a body possessing much greater stability than has been usually attributed to it; its aqueous solution will resist, without change, prolonged boiling, concentration, and exposure for weeks to the direct rays of the sun. It is true that repeated evaporation to dryness may partially decompose it, and it is of course destroyed by ignition.

Again, Vauquelin asserts that ammonia will precipitate the brown oxide of chromium from an aqueous solution of chromic acid through which sulphurous acid has been passed, and this assertion seems to be confirmed by some statements, made without quoted authority in Gmelin's "Handbook" (Cavendish Soc. Ed., iv. 114), concerning salts of the brown oxide of chromium obtained by dissolving this hydrated oxide in acids, from which solutions it may be again precipitated by ammonia. This is an important point in determining the real existence of such an oxide of chromium, and we have therefore made it the subject of careful experiment. We have dissolved in dilute chlorhydric and dilute nitric acids such precipitates as analysis had shown to have very nearly the composition which is expressed by the formula CrO_2 (as, for instance, the precipitate of analysis *d*, and of the analysis on page 145), and have added to the solutions ammonia of every strength, from the strongest to the weakest, and have so obtained one invariable result,—viz., a precipitate of common green chromic oxide, and a filtrate made yellow by chromate of ammonia. It is true that the fresh precipitate has a dirty or brownish look, caused by its impregnation with the yellow liquid in which it floats; and this is the most probable explanation of the opinion held by some previous observers, that this precipitate was something more than ordinary chromic oxide.

(To be continued.)

** *Ann. de Ch.*, lxx. pp. 85, 86 (1809).

On the Origin of Some Magnesian and Albuminous Rocks, by* T. Sterry Hunt, *F.R.S., of the Geological Survey of Canada.*

In common with other observers, I have long since called attention to the fact that silicates of lime, magnesia, and oxide of iron are deposited during the evaporation of many natural waters, such as the mineral springs of Varennes and Fitzroy, and the waters of the Ottawa River. I have also suggested that the silicates thus produced may have contributed in a considerable degree to the formation of rocks. (*Amer. Journ. Science*, March, 1860, p. 284.) A hydrous silicate of magnesia which approaches in composition to $MgO.SiO_3$, combined with from 10 to 20 per cent. of water, and mechanically mixed with small portions of oxide of iron, alumina, and carbonates of lime and magnesia, forms extensive beds with limestones and clays in tertiary strata, in France, Spain, Morocco, Greece, and Turkey. It is the sepiolite of Glocker, the meerschaum of some authors, the magnesite of others. The quincite of Berthier, which occurs in red particles disseminated in limestone, is a similar compound, containing some oxide of iron. The sepiolite from the basin of Paris occurs beneath the gypsiferous group, and in the lacustrine series known as the St. Ouen limestone, where it forms very fissile shaly layers, enclosing nodules of opal (menilite). The structure of this sepiolite, which I have examined and described as above, and that from Morocco, which is used by the Moors in their baths as a substitute for soap, and has been described by Damour, is peculiar. The mineral is made up of thin soft scales, and when moistened with water swells up into a pasty mass resembling a finely divided talc. Although agreeing closely with this mineral in the proportions of silica and magnesia, sepiolite contains more water, and both before and after ignition is soluble in acids, which talc is not. We cannot, however, doubt that talc and steatite have been formed from sepiolite, which has undergone a chemical change and become insoluble. It is possible that serpentine may be derived from another silicate richer in magnesia

* Presented to the Natural History Society of Canada.

than sepiolite. The frequent association of carbonates of lime and magnesia with talc, and of carbonate of magnesia, talc, and serpentine, as in the ophiolite of Roxbury, would seem opposed to the notion that serpentine may have been formed from the alteration of a mixture of sepiolite and carbonate of magnesia. In chlorite, which often forms rock masses almost without admixture, we have an alumino-magnesian silicate which cannot have been derived from sepiolite, inasmuch as this contains for the amount of magnesia present twice as much silica as chlorite. The oxygen ratios of the silica and magnesia in sepiolite are 3 : 1, and those of silica, alumina, and magnesia (including the variable amount of ferrous oxide which in part replaces the latter) in chlorite are as 6 : 3 : 5, while in the purest clays the ratio of silica and alumina equals 1 : 1, and in most argillaceous sediments the proportion of silica is still greater. It is evident, therefore, that chlorite could not be formed from a mixture of sepiolite with clay, or even with pure alumina, without the elimination of a large amount of silica, and we are led to regard it as having been generated by the reaction of a silicate of alumina or clay with magnesia, which was probably present in the unaltered sediment in the form of carbonate. Unless, indeed, the process, which, according to Scheerer, has in recent times caused the deposition from waters of neolite, a hydrous alumino-magnesian silicate approaching to chlorite in composition, be the type of a reaction which formerly generated beds of chlorite, in the same way as those of sepiolite or talc.

A silicate of lime allied to sepiolite has not, so far as I am aware, yet been noticed among unaltered sediments, and among crystalline strata calcareous are more rare than magnesian silicates, although double silicates of lime and magnesia (pyroxene and hornblende), often form beds, and wollastonite, either alone or mingled with carbonate of lime, sometimes constitute rock masses. The double silicates of alumina and lime are, however, abundant; the lime-feldspars, scapolite, epidote (saussurite), and white garnet, all form beds in crystalline rocks. Reactions in water at the earth's surface, and at no very elevated temperature, may have given rise to double silicates of lime and alumina corresponding to neolite, and allied in composition to the zeolites, and these by subsequent metamorphism have been changed into anhydrous silicates. The production of harmotome, chabazite, and apophyllite by the waters of a spring at Plombières, at temperatures not above 160° F., as observed by Daubrée, lends probability to such a view.

But while we admit the possible direct formation of double silicates in water at ordinary temperatures, there is not wanting evidence that the reaction which we long since pointed out (Proc. Royal Society of London, May 7, 1857), between siliceous and argillaceous matters and earthy carbonates, in presence of alkaline solutions intervenes in the metamorphism of sedimentary rocks and in the production of many siliceous minerals. The blue Silurian limestones of the Island of Montreal, when treated by acids leave an insoluble residue, which contains about 10 per cent. of soluble silica, mixed with an argillaceous matter whose analysis gave silica 73·0, alumina 18·3, potash 5·5, and only traces of lime and magnesia. In the vicinity of an intrusive dolerite, however, the limestone is changed in colour, and leaves by the action of acids a greenish matter, which consists of silica 40·2, alumina 9·3, peroxide of iron 5·2, lime 36·6, magnesia 3·7. The free silica and that of the intermingled aluminous silicate has thus been saturated with protoxide bases, still, however, retaining the alumina in combination. A similar reaction with more aluminous matters would give rise to epidote, garnet, magnesian mica, scapolite, or feldspars like labradorite and anorthite, and it is not impossible that in such reactions a portion of alumina may sometimes be set free, and give rise to corundum, spinel, diaspore, or völknerite.

In the ordinary modes of decomposition of minerals containing alumina, this base separates in the form of silicate, and the conditions required for its elimination in a free state are but imperfectly understood. We have elsewhere pointed out the decomposition by alkaline and earthy carbonates of solutions of sulphate of alumina or native alum as one source of free alumina, and insisted upon the existence of pigotite, a native compound of alumina with an organic acid, as an evidence that this base is sometimes, like oxide of iron (and oxide of manganese), taken into solution by water aided by organic matters. A hydrate of alumina, gibbsite, is found associated with limonite, and the aluminous minerals from the South of France described by Berthier and Deville, show that free alumina is much more common in nature than was formerly supposed. Berthier long since gave the name of bauxite to an earthy pisolitic ore which occurs either massive or imbedded in limestones of tertiary age at Baux and many other localities in the departments of Gard and Var, and also in Calabria and the Grecian Archipelago, forming in some places an abundant rock.† This substance is a variable mixture of a hydrate of alumina, apparently approaching diaspore in composition, with hydrous peroxide of iron, sometimes constituting a workable iron ore, and at other times a veritable ore of alumina. It contains besides small portions of silica, titanic, vanadic, and phosphoric acids, and occasionally encloses grains of corundum. A compact dark red variety gave Deville, alumina 57·6, peroxide of iron 25·3, and water 10·8, besides 3·1 of titanic acid and 2·8 of silica. In other specimens the proportion of alumina and iron oxide are nearly equal, or the latter predominates, as in one example where the proportions were 48·8 of iron oxide and 32·2 of alumina; and another, 60 of iron and 18 of alumina and titanium. In these analyses the carbonate of lime, generally present, was first removed by a dilute acid; the prolonged action of stronger acids completely dissolves the hydrated oxides. By an intense heat this substance is converted into crystalline corundum, resembling emery in its physical character, but the presence of grains of corundum in the hydrated mineral seems to show that the transformation may take place at ordinary temperatures. The emery of Greece and Asia Minor, which is associated with variable proportions of oxide of iron, is, according to Dr. J. Lawrence Smiths, always more or less hydrated.

The argillaceous matter enclosing some varieties of this bauxite or impure diaspore is white, without plasticity, and very rich in alumina. One specimen freed from the red ferruginous portions gave, alumina 58·1, silica 21·7, peroxide of iron 3·0, titanium 3·2, water 14·0. This substance approaches in its composition to collyrite, and the dillmite which is the gangue of the diaspore of Schemnitz. These materials, however, contain from 20 to 40 per cent. of water. Scarbroite, schrotterite, and allophane are similar matters; the latter, unlike a clay in its structure, appears to have been deposited from solution. The subsulphate of alumina, known as websterite or aluminite, is often met with in layers and concretionary masses in tertiary clays,‡ and is sometimes

† Deville, *Ann. de Chimie et Physique*, (3) lxi. 309.

‡ In this connection we may notice apatelite, a basic persulphate of iron, which occurs in conditions similar to aluminite.

mingled with a silicate having the composition of allophane. This frequent occurrence of alumina still retaining a portion of sulphuric acid, confirms the view which we have elsewhere expressed, that solutions of native alums have by their decomposition furnished the alumina for many of the minerals in question, while the conditions under which this base is taken into solution by organic matters still require investigation. The careful examination of unaltered sedimentary deposits is calculated to throw great additional light upon the origin of the crystalline rocks.

On a New Method for Determining the Nature of a Mixture of Colouring Principles, by M. le Docteur Frédérich Goppels-Rœder, *Professor at the University of Basle.*

Some time ago M. Schönbein presented to the Société des Sciences Naturelles of Basle some very interesting observations on the different heights to which divers bodies held in solution rise by imbibition in the pores of blotting-paper.

In these facts the author finds the key to a new method of analysis, and, in conjunction with M. Schönbein, has investigated the behaviour of colouring matter from this point of view.

Picric acid is remarkable for the facility with which it enters the pores of the paper, and this property distinguishes it when mixed with other colouring matters possessing less power of infiltration. Thus, a mixture of picric acid and turmeric in aqueous solution is determined with great ease by the partial immersion of a strip of porous paper. Above the point of immersion three bands will be observable,—the topmost very narrow, containing water only; the central one broad, and coloured by picric acid; the lowest one also yellow, but deriving its tint from the turmeric. In fact, when the paper is plunged into a potash solution the middle band of picric acid disappears, while the lower one takes a brown tint. It is obvious that the separation is not complete, the lower bands always containing more or less of the principles which have mounted to the upper bands.

A mixture of aqueous solution of picric acid with a very dark solution of sulphate of indigo, producing a beautiful green colour, gives on the paper sometimes three, sometimes four bands.

If the liquid is of a free green colour, four bands are obtained, namely, the lowest broad and green, next above a narrower yellow band, the third colourless, containing sulphuric acid, as can be proved by a drop of litmus tincture; and lastly, a band of pure water, which is absent if the sulphate of indigo is in excess, for in this case the presence of too large a proportion of acid prevents the separation of the water and acid.

This method is equally well adapted for a mixture of murexide and picric acid. If the proportion of picric acid is very small, there will be formed—1. A lower band, purple and very broad. 2. A middle stripe, narrow and yellow; and lastly, the highest stripe purely aqueous. If, on the contrary, the mixture contains a large proportion of picric acid, the yellow middle band is larger, and the first, instead of being purple, is only reddish-yellow.

Picric acid is found in the same manner when mixed with fuchsine (hydrochlorate of rosaniline).

The existence of picric acid in crude fuchsine has not hitherto been proved, but the results given by this product with the strip of paper show that picric acid usually accompanies the red product.

By the immersion of several millimètres of a strip of filtering paper in an alcoholic solution of pure crystallised fuchsine, the rapid aspiration of the coloured liquid is effected.

After the lapse of a few minutes four bands will appear; the highest, containing alcohol only, colourless, the three others coloured with various shades of pure red, from light rose to dark, almost black, red. The darkest band will be in the middle. The addition of a little picric acid modifies these appearances, and produces three kinds of bands—1. Dark red and rose coloured bands; 2. Colourless bands; 3. A beautiful yellow band, due to the picric acid. In proportion to the increase of picric acid the yellow band broadens, and the red-brown one produced by the fuchsine diminishes.

Crude commercial fuchsines behave in exactly the same way as the preceding mixture. In alcoholic solution they all give, besides the red bands, a larger or smaller yellow band.

Thus the author has undertaken an extensive series of researches both with solutions of pure colouring matters and with mixtures, and he is convinced that this ingenious process will prove very convenient for distinguishing rapidly the nature of colouring matters in mixtures, especially if well-chosen and characteristic reagents are used, so that applied to well-defined bands they will give precise indications of the kind of colour isolated by infiltration.

This mode of analysis may also prove useful in medico-legal researches; for instance, in ascertaining the presence of picric acid in beer, or of various colouring principles in wine, syrups, pharmaceutical extracts, &c.—*Répertoire de Chimie pure et Appliquée.*

On the Preparation of Inorganic Carbon, by George Gore, *Esq.*

Intimately mix one part of amorphous phosphorus and two parts of anhydrous carbonate of soda, both in fine powder; project the mixture, in small portions at a time, into a red hot clay crucible, keeping the crucible covered as much as possible, and not adding each fresh portion of the mixture until the white flame of burning phosphorus (which issues from a small hole in the cover) has quite disappeared. Digest the porous and cooled residue in water, filter, and wash until all alkalinity has disappeared. An abundant residue of exceedingly light carbon will be obtained, which, when dried, will be equal to about four-fifths of the calculated quantity, if the process has been carefully conducted and the crucible kept well covered.

A similar experiment made with anhydrous borax instead of carbonate of soda yielded no boron.

The following modification has on several occasions succeeded well as a lecture experiment:—Into a long and narrow test-tube, of German glass, place first a fragment of white phosphorus about the size of a large pea, then fill a length of about two inches of the tube with anhydrous carbonate of soda in powder; support the tube at its mouth in a horizontal position; heat the end of the carbonate most distant from the phosphorus to redness by a lamp, and then apply a moderate heat to the phosphorus by gradually shifting the lamp towards that end; the instant the phosphorus melts and volatilises, the whole of the red hot carbonate becomes quite black, and exhibits a striking contrast to its previous whiteness.

TECHNICAL CHEMISTRY.

*The American Oil Wells.**

(*Continued from page* 150.)

Different opinions exist respecting the source of petroleum. Professor Silliman states that it is of vegetable origin, and was produced by the agency of subterranean heat. This is a very general but unsatisfactory opinion. Geologists most generally believe it to be derived from bituminous shales situated below the coal formations. It is commonly found in the American rocks called the Portage and Chemung Group. This group of rocks is of immense thickness on some parts of our continent, being no less than 4900 feet thick in Michigan. The bituminous shales called Utica Slates have yielded large quantities of oil in Canada by distillation, and the spouting petroleum wells of Enniskillen are in this formation. But petroleum is not always found in this class of rocks, as no oil has been found in various parts of New York State, where these rocks have been bored to a great depth.

Many practical men in the Alleghany and Ohio valleys believe that petroleum has its origin in coal-beds. They assert that a low heat in the coal seams drives off hydrocarbon vapour, which is condensed in the pores of the rocks and the soil, and is washed by rains into subterranean recesses, situated at various depths in the rocky strata. Coal is found in all the hills adjacent to the petroleum wells in Pennsylvania, Ohio, and Virginia. Cannel-coal is abundant in the hills within one mile of Oil Creek, Pa. Is it not reasonable to suppose that reservoirs of petroleum must be situated at a considerable height above the level of the ground where all the overflowing wells are pouring out their oily fluids? In all artesian wells the water rises to the height of the fountain head, and the same law must prevail in petroleum wells. May not the reservoirs of the petroleum spouting wells be situated far above the level of the rocks where the oil is tapped in boring? The proprietor of a petroleum well near Parkersburg, Va., has assured us that the oil obtained in his well is of the same character as that derived from the coal in its vicinity by distillation. It is a heavy oil, more unctious than the common petroleum of Pennsylvania, and it is chiefly used for lubricating machinery. It is well known that oil of different qualities is obtained from different coal beds, and the petroleum of the United States differs in several characteristics from that of Canada.

Facts would appear to favour the theory that petroleum wells have two sources of supply, namely, coal-beds and bituminous shales. In Western Pennsylvania, Ohio, Michigan, Virginia, and Kentucky, petroleum is usually found in the vicinity of coal seams, and it was a petroleum well in England, situated close to a coal-bed, which suggested to James Young the idea of distilling coal at a low heat and obtaining oil therefrom. The commercial success of his efforts led to the very extended use of such oil, and finally to the very general application of petroleum for light.

This much may be accepted in favour of coal-beds in certain localities being the sources of petroleum. On the other hand, petroleum wells are found in Italy, Sicily, Syria, the Crimea, Persia, Siberia, and Canada, very far removed from coal-beds, but where there are bituminous shales, and this kind of petroleum differs frequently in several essential features from that which is found in coal regions. The Canadian crude petroleum far surpasses that of Pennsylvania for concentrated stench, and we can easily credit it with a lower, older, and different origin.

Geologists who adhere to the idea that bituminous shales are exclusively the source of petroleum, will be pleased to make a distinction between the source of the decent, clear oil obtained at Smith's Ferry, on the Ohio River, and that found north of the upper lakes. But whatever may be the source of petroleum, and whatever theory may be the most plausible, it must be admitted that we are unacquainted with most of the operations of Nature in the interior of the earth. The most important question is, will not our present sources of petroleum soon become exhausted? In answer to this it may be stated that petroleum springs have been known, and the petroleum used to some extent, for thousands of years. Thus, in the Island of Zante, in the Mediterranean, there are two springs which have been open many thousand years, and the more rapidly the substance is removed from the wells, the more powerful and prolific the springs become. If this has been the case with the petroleum springs of Zante, may it not be so with those on our continent?

Petroleum, or rock oil, may not always be a proper name for this peculiar substance. It is found in swamps and peat bogs as well as rocky strata. In the swampy forests of Borneo the Dyoks collect petroleum from the surface of ponds, but all the flowing wells in America have been sunk to a considerable depth in rocky strata.

(To be continued.)

* From the *Scientific American.*

*On Improvements in the Manufacture of Peat Fuel,** *by* C. Hodgson, *Esq.*

There are few subjects which have attracted more general attention in this country, or which have been pursued with so little success heretofore, as that of the utilisation of peat on any large scale. The land is burdened with nearly three million acres of bog, which, by resisting the efforts of the cultivator and impeding local intercourse, go far to neutralise any *recoupement* derived from them in the shape of an inferior fuel obtained in most seasons with difficulty. It is therefore but natural that many efforts should have been made to turn these barren wastes to some useful purpose, and consequently we find from time to time the philanthropist, the speculator, and the man of business emulating each other in this pursuit. But one common enemy has hitherto baffled the efforts of all classes, rendering abortive the most ingenious contrivances for the solidification of peat into a compact fuel, and frustrating the most elaborate chemical processes for the development of its more valuable constituents. This grand obstacle to progress is water, which is capable of being absorbed by peat in an almost incredible proportion, and of being retained with an obstinacy not easily overcome. It is this property in peat which has hitherto baffled so many efforts to convert it into a more available fuel. In the first place, it is exceedingly difficult to deprive blocks of peat, however small, of the contained water; and secondly, as the water does evaporate to a certain extent, air replaces it, keeping the pores much distended, so that a bulky and importable substance results, which always contains from 20 to 30 per cent. of water. Few of those who have given their attention to this subject have appreciated the magnitude of this practical difficulty.

* A paper read before the Institution of Civil Engineers of Ireland.

Very many have even omitted to test thoroughly the average quantity of moisture in our peat bogs, and will not believe the reports of those who know from actual experience how much water the Irish peasant raises and spreads out upon the ground in order to obtain a ton of fuel. Even very lately a pamphlet appeared, on the strength of which it was intended to found a commercial undertaking, and which assumed, as its starting-point, a proportion of contained water not more than one-fifth of that which actually exists. The following table gives the average of several hundred tests by careful evaporation, showing the quantity of water contained in peat in different conditions of the bog; and in various stages of desiccation, under the ordinary method of cutting and air-drying, no attempt is made to distinguish between the light and dark brown and black varieties of peat, as the quantity of water contained depends far more upon its position in the bog drainage and upon the amount of drying which when cut it has received, than upon the ordinary difference of quality:—

	Water.	Peat.	Water.	Peat.
The general mass of undrained peat bogs, not including the edges or the heathy surface . . . from	92 +	8 to	95 +	5
Bog edges and parts of bog, more or less drained, in the state in which peat is generally cut . . from	88 +	12 to	91 +	9
Thin upper surface of a well-drained bog for about 1 inch deep, all vegetation being cleared off . . from	75 +	25 to	82 +	18
Turf in the state in which it is usually "footed," or raised into small piles . . . . . from	75 +	25 to	80 +	20
Turf when ready to clamp or build in larger piles . . . . from	50 +	50 to	60 +	40
Turf ready to stack . . . . „	25 +	75 to	35 +	65
Turf as generally used . . „	20 +	80 to	35 +	65
Carefully stacked turf, kept from 6 to 12 months in stack . . . from	18 +	82 to	20 +	80
Turf well saved, and kept in a dry house for about two years . from	12 +	88 to	15 +	85

It will thus be seen that no small obstacle lies in the way of those who would prepare peat for burning, by whatever method it be attempted; but those who have calculated on obtaining by the common system any considerable supply for commercial purposes from a single district of bog have been met by the peculiar practical difficulty which besets this manufacture. For when large quantities of common turf are required, contrary to the usual rule in other productions, which diminish in cost proportionably with an increased make, the price of peat per ton is found inevitably to increase directly its manufacture is stimulated beyond a certain very moderate limit. The cause of this is obvious; the turf cutter can only work round the edge of a bog or upon occasional main drains. So long as he wishes only to produce a small quantity from a given length of bank he can himself spread the sods as he cuts them. If, however, more is required he must be attended by a wheeler, which at once doubles the cost, and where there is a belt of land of more than 40 yards wide to be covered, two or more wheelers are necessary. The cost of again collecting the dried turf and concentrating it at any given place, of course increases *pari passu* with the increased cost of spreading. To give some idea of how much produce can be practically counted upon within a given district, it may be stated generally that from 1000 to 1500 tons obtained from a line of turf banks an English mile long is a large yield for one whole year's operations, and that this can only be completely prepared, brought down from the bog, and delivered at road or water side, at a cost of about 5s. per ton. If, however, a number of small farmers were to cut from the same mile of banks about half the above quantity, it would probably cost them about 3s. per ton similarly delivered; whereas, on the other hand, if it were desirable, or even possible, to obtain say 2500 tons from the same locality, it could only be effected at a cost of 7s. to 8s. per ton, and much of the peat would only receive indifferent drying, from being necessarily carried back on to the interior of the bog. The truth of these observations was clearly and unfortunately demonstrated in the case of the late Irish Peat Company, who required at their works near Athy a constant supply of 50 tons per day, or as much of that quantity as could possibly be obtained, for the manufacture of oil, tar, paraffin, &c. Relying upon the statements of several writers, probably corroborated by their first experience of producing small quantities for experiment, they assumed that the common turf of the country (their raw material) would cost them 2s. 6d. to 3s. per ton; but they soon found that cost increased to 5s., and long ere they had secured even the minimum supply required to carry on the works with a prospect of commercial success, they found their average cost of peat to be from 6s. 6d. to 7s. per ton, and this increase of outlay, coupled with the downright impossibility of obtaining a much larger supply, were amongst the proximate causes of failure in that truly enterprising effort. Turning from this part of the subject, and admitting that peat manufactured in the ordinary way is a cheap and useful domestic fuel for those who can cut it for themselves and use it on the spot, we come to the main object of this paper, viz., a discussion on the improvements attempted or introduced in the above manufacture. And here it will be advisable to recapitulate the obvious defects in common peat which require to be corrected, the properties which it is desirable to develope in it, and to state generally its constituents as a fuel when compared with coal and other combustibles, thus setting before us what has to be done in the matter, what kind of article we may hope to produce, and what will be its value. Common turf, independent of any difference in chemical constitution, has in itself and in its mode of preparation five main defects, which render it practically inferior to coal; first, the consumer never obtains it in a sufficiently dry state to give its full effect in combustion; secondly, as from one-third to one-fourth parts by weight of the peat of commerce is simply water, the consumer is always obliged to pay carriage on one ton of water for every two or three tons of actual fuel he receives: this constitutes a disadvantage quite distinct from that last named; thirdly, it is so bulky and porous an article that it is impossible to convey it as cheaply as coal, and for the same reason it requires much larger arrangements of fire-grate, &c., to produce a given effect than is required for the same with coal, and from its lightness (though capable of producing a very intense heat) it will not bear the stimulation of a powerful blast; fourthly, the manufacture of common turf depends at all times upon favourable weather,—its supply is therefore always precarious; fifthly, from the circumstances already explained, it is impossible to obtain a large quantity of fuel, as much, for instance, as would be extracted from a coal mine of very moderate capacity, from any one estate or even considerable tract of bog. The qualities, therefore, to be produced in an improved fuel from peat so as to raise it as nearly as its chemical constitution will admit to the standard of coal, are as follows:—

1. Perfect, or nearly perfect, dryness, so that all the

substance paid for by the consumer may be actual fuel, and not partly water, retarding combustion and increasing the cost of carriage.

2. Density, if possible, equal to that of coal, so that it may rank equally with coal in capability of transport (a most important quality), and also be a sufficiently compact fuel to be used with advantage in the same fire-grates generally in use for coal.

3. Hardness or tenacity, which to a great extent accompany density, enabling the fuel to be moved without much loss from abrasion, to be consumed in strong blast furnaces, or possibly to support the burden of metallic ores under reduction.

4. Any improvement in the mode of manufacture must include the completion, at least, of the drying process by artificial means, or else perfect dryness can never be attained, nor can any amount of dryness be depended upon with certainty in this climate.

5. Whatever method is adopted for natural drying previous to finishing by artificial means (it being impossible practically to dry from the primitive state artificially), it must be such as shall produce a partially dry substance in large quantities without incurring an increase of cost in proportion to the increased demand for it. We now come to consider the chemical constitution of peat, and its consequent theoretical value as compared with coal. Finding many discrepancies in the various analyses extant, both of coal and peat, which probably arise as well from difference of manipulation as from the considerable variation in quality of each fuel, it is fair to take a mean analysis in both cases. The following may be relied upon as representing the general constituents of each substance :—

Peat.		Coal.	
Carbon	57 per cent.	Carbon	85 per cent.
Hydrogen	6.5 ,,	Hydrogen	4 ,,
Oxygen	32 ,,	Oxygen	3 ,,
Ash	4·5 ,,	Nitrogen	3 ,,
		Ash	5 ,,
	100		100

Comparing these analyses, it will be seen that almost the only essential difference between the two fuels regarded as calorific agents is, that peat is deficient of carbon by about one-fourth of the quantity contained in coal, its place being taken by oxygen; and as fuel in combustion can receive all the oxygen it requires from the atmosphere, it is manifest that any contained in the fuel cannot be taken as a portion of its value. Of hydrogen, which is four times the value of carbon as a calorific agent, peat generally contains a little more than coal, but this excess cannot safely be counted upon, as a considerable portion must be supposed to combine with oxygen, and forming water, to be partially lost as an effective agent.

We must, therefore, look to the proportions of carbon in each as the best test of the relative value of the two fuels, and from this we arrive at the conclusion that the duty of perfectly dry peat ought to be two-thirds that of average coal.

And here it may be stated that this theoretical value is now found to be fully borne out in practice, for with compressed peat perfectly dry two-thirds the duty of coal has been repeatedly performed during the last twelve months. In two qualities of no small importance peat does excel coal. It contains very little or no sulphur, which is of great advantage to any metal exposed directly to the action of its flame, and in scarcely any variety does the ash vitrify,—a defect in most coal which is productive of much trouble to the firemen, and considerable waste of grate bars. Relying on the excellence to which it thus seemed possible to bring peat fuel when those disadvantages were overcome on the one hand, and these perfections obtained on the other, many men have started with high hopes and eager anxiety to carry to a successful issue so desirable an enterprise, and, so far as the actual physical possibility of the matter, many have succeeded. But unfortunately in these degenerate days, physical possibility is of no use whatever, unless it be accompanied by the far more important qualification of financial possibility. It is an easy and a pleasing pursuit to try what good things can be made out of comparatively worthless materials, but it only becomes a useful pursuit to the operator and to mankind in general when the "good things" are intrinsically more valuable to humanity than the labour and material which have produced them.

(To be continued.)

On a Process for Covering Copper or Brass with Lead.

By plunging a copper or lead wire in close contact with a bar of tin into a hot alkaline solution of oxide of lead, the wire becomes covered with a layer of lead, while the tin dissolves in the form of an alkaline stannate. M. Haeffely has made use of this reaction to prepare commercial stannate of soda; but the lead is precipitated in a spongy state,* whilst immediately on the introduction of a copper wire into the liquid the lead collects on the wire, spreading evenly over it. The layer thus formed adheres sufficiently to allow of the covered copper being made into evaporating apparatus. However, when submitted for some time to the action of heat, the lead becomes detached.

Were it possible to render the layer of lead very adherent and not porous, this process would be of great service in the manufacture of chemical products. In evaporating acid liquids, copper vessels lined with lead could be used instead of leaden vessels, their thickness being inconvenient.—*Polytechnisches Centralblatt*, p. 278. 1862.

PHARMACY, TOXICOLOGY, &c.

New Tests (?) for Phosphorus in Cases of Poisoning.

The following report on an alleged case of poisoning by phosphorus has been forwarded to us from Jamaica:—

"Kingston, July 28, 1862.

"Edward Evans, Esq., Coroner for St. James.

"Sir,—I have the honour to report the result of analysis of the viscera of Mr. Edward Foster, of Montego Bay. The two jars containing the viscera were received carefully packed from the hands of the policeman entrusted with their safe carriage. The seals securing the corks were perfect, and showed plainly that the jars had been transported with great care. On examination of the contents of the jars, I found the stomach and liver in a good state of preservation and accompanied by about a pint of a sanguinolent fluid which had an acid reaction. The muscular part of the stomach was much corroded, that is, weakened, so that pieces of it could readily be torn off without the exertion of much force. The stomach itself was dark red from suffused blood. The intestines of the second jar were equally well preserved. I took a portion of the contents of each jar, for the purpose of testing for arsenic and

* By the following reaction :—$2PbO+Sn=SnO_2+Pb_2$.

other metallic poisons, and suspecting the nature of the poison present, I put a clean piece of filtering paper on each of the corks of the jar, closed the jars carefully with the corks, and put them aside in a warm place. The analysis for metallic poisons demonstrated the absence of arsenic, &c., but revealed the presence of a rather large quantity of phosphoric acid. After allowing the jars to remain undisturbed for three weeks, I proceeded to the examination of the paper on the corks. The paper on the cork which closed the jar containing the stomach and liver with the sanguinolent fluid was quite moist and corroded; but the paper on the cork covering the jar with the intestines, was completely covered with glittering microscopic crystals. Viewed under the microscope magnifying about 350 times (linear) these crystals exhibit very much the shape of the blade of a cork knife, or by adhesion of two crystals (the forms of the crystals given). These crystals are phosphate of ammonia, and can only be formed under the circumstances indicated when phosphorus *in natura* is present in the viscera. This test for phosphorus is a discovery of my own, which I have repeatedly verified, as well as another test also discovered by me, and presently to be mentioned. The test for phosphorus, which is regarded by chemists as the most sensitive and as the most certain up to this day, is the test of 'Mitscherlich' by which the presence of phosphorus is revealed to the eye through the property of phosphorescence, when viscera are distilled in an apparatus constructed entirely of glass, the operation of distillation being performed in a dark room. I have proved, however, quite lately, that small quantities of phosphorus cannot be detected by this method in large masses of putrefying animal matter, and have indicated a process, the correctness of which I have since proved over and over again. This process consists in distilling from the viscera, mixed with sufficient water and a small quantity of dilute sulphuric acid, about two drachms of fluid, mixing a few drops of sulphide of ammonium with the distillate, and evaporating the whole to dryness in a porcelain dish. If phosphorus were present in the viscera, even in the most minute quantity, a drop of a solution of perchloride of iron, when allowed to run down the side of the porcelain dish, will produce a deep violet and brownish evanescent reaction. This test was also applied to the viscera under consideration, and a most powerful reaction obtained, leaving not the slightest doubt as to the presence of phosphorus *in natura* in the viscera of Mr. Edward Foster.

"Taking, therefore, in consideration the acid reaction of the sanguinolent fluid, the presence of a large quantity of phosphoric acid, the formation of the microscopic crystals of phosphate of ammonia, and the result of my last-mentioned test for phosphorus, with the perchloride of iron, I unhesitatingly declare that the sudden death of Mr. Edward Foster was the effect of a poisonous dose of phosphorus.

"I have the honour to be, Sir,
"Your most obedient servant,
"L. Hoffman, Island Chemist."

We have nothing to say to this report further than that we have tried Mr. Hoffman's sulphur test without obtaining the reaction he describes; and that, as most of our readers are aware, the process is exactly that of Liebig for the detection of prussic acid, of which poison one of the medical witnesses in the case, Dr. Wilson, gave it as his opinion that the subject of the inquest died. It would seem, however, highly improbable that prussic acid should be found after the viscera had been kept in a warm place for three weeks.

The production of phosphate of ammonia under the circumstances described, is curious, if true; but we have great doubts of the value of this as a test in toxicological examinations. We have no need of more delicate and certain tests for phosphorus than the process of Mitscherlich, and the reducing action of an alcoholic solution obtained by distilling suspected matters with alcohol. The subject, however, deserves investigation, that the authorities of Jamaica may know how much faith to put in future reports of the Island Chemist. The next case he reports on may be a supposed murder, and the result may be the hanging of some one. Happily this was only a suicide.

Our attention has also been directed to a case nearer home, a report of which we borrow. It will be seen that in this case no chemical means at all were used to discover the poison; but it was said that the contents of the stomach were given to a rabbit. We should be glad to know what quantity of matter was found in the stomach, and how it was prepared for administration to the rabbit? How much the rabbit swallowed?—in fact, all the details of the experiment.

"*Alleged Suicide of a Chemist.*

"Mr. W. Payne, the Coroner for the City of London, resumed the inquiry touching the death of Mr. John William Northgate Brewer, aged 29, who was alleged to have committed suicide on Tuesday last, under the following extraordinary circumstances:—

"It appeared from the evidence that deceased was a chemist carrying on a good business in Liverpool-street, but that his health was broken, and that he frequently threatened to commit suicide. On Tuesday evening, about five o'clock, he came down from his room to the top of the kitchen stairs, and asked the servants where Mrs. Brewer was? They answered that she was upstairs, when he said, 'I will take prussic acid, and get rid of it.' They noticed that he had a glass in his hand containing about half an inch of opaque liquid, and he went over to a tap and poured some water into it and drank the whole off. He then called out 'I have done it, I have done it;' and throwing the glass into a pail close by, fell forward on the stairs, and breathed very faintly. Medical assistance was immediately procured, but deceased was manifestly dying, and though he continued to breathe slightly for half an hour, he died, as his medical attendants supposed, at the time from poison. A post-mortem examination, however, was made two days afterwards, with the following result:—

"Dr. Brown said that he and Dr. Gibbon and two surgeons examined the body, and found the brain diseased. The lungs were also diseased. The heart was malformed, there being only two instead of three valves. The contents of the stomach showed not any trace of prussic acid or other poison. Neither did the blood. In the opinion of the medical men death resulted, not from poison, but from failure of the heart's action, resulting from congenital malformation.

"The Coroner asked if traces of prussic acid might not have disappeared after death?

"Witness replied that any quantity of that poison that would be sufficient to cause death would leave a post-mortem trace.

"Dr. Gibbon concurred in that opinion, and said *that the contents of the stomach, when given to a rabbit, produced not the slightest symptom of poisoning.*

"The Coroner said that the case was a most extraordinary one; but the jury, he thought, would have no option but to be guided by the medical evidence, even though there might be something in which they could not quite account for.

"The jury having deliberated in private, returned a verdict in accordance with the medical testimony."

Hydrargyrum cum Cretâ.

In the *Berkshire Medical Journal*, Dr. Samuel Duncan, of Williamstown, Massachusetts, has an article upon the hydrargyrum cum cretâ. We have space only for the doctor's conclusions:—

"1st. When this preparation of mercury is exposed to the light, especially during the summer, a portion of the suboxide which it contains is decomposed into the metal and red oxide (protoxide), which, in sufficient quantity, always acts as a violent instant poison.

"2nd. That the older the preparation and longer the exposure to light, the less the mercury and greater the amount of the oxide.

"3rd. That in order to have a perfectly reliable article of hydrargyrum cum cretâ, it should be made of pure material, kept in a cool place, and excluded from the light.

"4th. That freshly-made and light-coloured specimens are best, and those of a deep colour should be rejected.

"5th. That this preparation is unstable; that it tends to separation by the volubility of its mercury, and the superior mobility and gravity of its particles.

"6th. That we have no reason to suppose that mercury, however pure, exerts any influence on the system in its metallic state, but that it must first be converted into an oxide, and this oxide must be basic to a soluble compound; and that the amount of suboxide in hydrargyrum cum cretâ is not at all injurious, providing, however, it remains as such; and that when this preparation proves an irritant in itself, it is due to a higher degree of oxidation."

In the same journal above referred to, Dr. H. M. Seely has an article upon the same subject. Considering the subject of importance, we make a few extracts:—

"As it has been observed that samples which, when fresh, were administered with desirable results, were found, after a time, to lose their character and to degenerate, some other cause aside from improper manufacture must therefore be sought.

"The fact just mentioned, that samples at first reliable become useless, compels us to look for a change in the material itself. Does the metallic mercury in its finely divided condition become gradually oxidised, so that not only metallic mercury, but one or both of its oxides are administered?"

After describing several processes of analysis, he observes:—

"Of a specimen thus analysed, which originally should have contained 37·5 parts of metallic mercury, 22·25 parts had changed to the red oxide, and 4·05 parts to the black oxide, leaving less than a third of the metallic mercury in its original condition.

"With a knowledge of such a change in the character of the metallic mercury before us, we need look no further for the cause of the alarming result attending the use of long-kept samples of hydrargyrum cum creta; the oxide existing in the powder produced by the gradual oxidation of the finely divided particles of mercury probably being converted in the fluids of the stomach into compounds of a more energetic character.

"These facts will hardly deter those who have been accustomed to prescribe this preparation with satisfactory results from continuing its use, for, as heretofore, they will secure fresh samples from trustworthy manufacturers. If at any time they find the result of their prescription different from what was anticipated, they will at once suspect the cause, and rejecting the deteriorated sample, resort to a new and reliable one.

"Those who have abandoned its use will hardly return to it, preferring to rely on the metallic mercury in the form of blue mass, in which the metal, though finely divided as in the cretaceous powder, is not so liable to oxidation, surrounded as every little particle is by a viscous covering, shutting off the oxygen of the air.

"The knowledge of these facts should lead either to a very careful selection of this preparation, or to the substitution of one of a less variable character."—*Med. and Surg. Reporter.*

NOTICES OF BOOKS.

Report Addressed to Her Majesty's Principal Secretary of State for the Home Department, relative to the Grievances complained of by the Journeymen Bakers. 1862.

Mr. Tremenheere, the author of this Report, is evidently a good-tempered amiable gentlemen. He does his best on all occasions to make things pleasant for everybody. Does a journeyman baker in his evidence detail an extremely uncomfortable condition of things which once existed at one of Her Majesty's bakers, Mr. Tremenheere is careful to inform his readers in a note that matters have been greatly improved since that time, and refers to the evidence of Her Majesty's baker in proof of it. Does a witness aver that some Edinburgh masters after trying Mr. Stevens' bread-making machine abandoned its use, Mr. Tremenheere adds in a parenthesis "(But see § 178);" and we turn to § 178, and find merely a statement of the sizes and prices of Mr. Stevens' machines, by which we are not much enlightened as to the cause of their abandonment. With regard to these machines we are bound to say that there is in this Report a large amount of evidence strongly in favour of them, and apparently with good reason. The saving of labour involved in their use is placed beyond a doubt; but perhaps the greatest recommendation is the cleanliness of the process. Dough kneading is very hard work, and as the journeymen lean over the trough belabouring the mass, streams of perspiration pour from their heads and are necessarily absorbed by the "sponge" they are manipulating. And again, in the ordinary process, after the kneading is completed it is necessary for the men to wash the adhering dough and flour from their hands and arms. If this were done at a sink it would involve a loss of at least a halfpenny-worth of flour per man to the master; so the washing is performed in a pail, the contents of which are set aside to go into the next batch of bread. Now there is something extremely disagreeable in these revelations, and they tell very strongly in favour of any form of machinery which shall prevent such contaminations.

Dr. Dauglish also urges the cleanliness of his process, and perhaps to most of our readers this will be the strongest point in the Doctor's evidence.

The human hand has no need to come in contact with the materials in any part of the process. The Doctor's evidence is merely a condensation of the paper which he read at the Society of Arts, and of which we gave a report at page 260, Vol. 1. We need not therefore repeat it here. It does not appear to have been yet determined whether the cerealine (the retention of which is the principal recommendation of the process of dressing flour which Dr. Dauglish advocates) is to be found in the bread in a condition to assist in the digestion of gluten and starch, and so to have any value beyond that which attaches to gluten itself. We believe that at the temperature necessary to bake bread properly, the cerealine would become so much altered as to become unavailable as a "catalytic agent." Nor are we disposed to endorse Dr. Dauglish's opinions as to the evils resulting from the use of fermented bread, at which, however, he rather

hints than expatiates upon. Unlike the authorities we quoted last week, who condemn the use of alum, Dr. Dauglish admits *several* causes of deranged digestion in adults, which may not be improved by the withdrawal of the fermented bread, and consequently the alum. Great importance is placed by the Doctor on the possible non-destruction of the yeast plant in slack-baked bread. "It is not difficult," he says, "to understand how the most painful and distressing symptoms and derangements may follow the use of bread in which the yeast plant has not been thoroughly destroyed. When the functions of digestion are weak, they are in most cases incapable of preventing the development of the yeast plant in the stomach, and the consequent setting up of the alcoholic fermentation to derange the whole process of digestion and assimilation." This is a point which deserves further investigation at the Doctor's hands, and we commend it also to the attention of any of our medical readers who may be studying the causes of indigestion. Did any one ever see *torulæ* which could be fairly traced to bread in vomited matters? And is it an absolute fact that "in order to destroy it (the yeast plant) it is necessary that the bread should attain, and remain for some minutes at the heat of 212°?" We know that fermentation reappears in matters which have been submitted to a boiling heat; but is it without the accession of a new ferment?

We shall not stay to enter upon these questions. They deserve a longer discussion than we can give them here at present, and we hope they will in time receive it. We turn instead to the economic advantages which Dr. Dauglish urges will result from the adoption of his plans. The loss of nutritious matter consequent on the fermentation of starch he estimates at from 3 to 6 per cent., which may be estimated at the value of 1,500,000*l.* in the total quantity of bread made annually in the United Kingdom. The gain of 10 per cent. in the new mode of dressing flour he estimates will give an increase of nutritious material for human consumption equal to the value of 6,500,000*l.* sterling. This second item is important, and shows how much we sacrifice to appearances, for all this sum is thrown away that we may have a tolerably white loaf. It is a misfortune that with all this gain, aërated is much dearer than common bread, a fact which Dr. Dauglish will be sure to find to militate against its adoption by the vast majority of people. It is vain to assure the masses that aërated bread is more nutritious and a smaller quantity will suffice for human wants. Quantity is a great element in feeding. If the nutriment of a 4lb.-loaf could be compressed into four small lozenges, no one would eat the lozenges if they could get the bread. And so bread made of "cones," and even of adulterated "cones," will be sure to command a sale even in respectable neighbourhoods where aërated bread at an advance of twopence per loaf will be unasked for. The Patagonian when on short commons will make it up with clay. The Englishman must have a large quantity of bread, even if his circumstances compel him to buy it made of Indian corn, rice, and bean meal.

The remedies for the grievances of the journeymen bakers we need not discuss,—the bakers themselves cannot agree on those points. Make a baker take out a 10*l.* licence, which will shut up cheap shops, says the capitalist baker; abolish journeymen bakers almost entirely by eating aërated bread, says Dr. Dauglish; stop youths from working in bakehouses at night, say the men, who naturally want higher wages, and all will then be righted. Mr. Tremenheere is evidently in favour of abolishing the journeyman as the best means of improving his condition, and strongly advocates the exclusion of youths from bakehouses at night. He is in favour, too, of making the provisions of the Adulteration of Food Act more effectual, and of stringently carrying out the Act, which should compel the bakers to stamp loaves made of mixed meals with a Roman M, and upon wheaten bread a large Roman W H.

In the latter recommendations we quite agree with the author. Let the public know fairly what it is they buy, and if a baker puts potatoes or bean meal into a loaf which he stamps as wheaten, fine him, and we shall be glad to hear that the condition of the journeymen bakers is improved by the process. Meanwhile, the morals of many journeymen bakers, it seems, require improvement. They are, it appears, in the habit of making considerable "irregular gains." The process "consists in entering in their books more bread to their customers than they have delivered." The pamphlet from which the author quotes says, "Of the heads of small families not one in ten escapes paying for half a quartern loaf per week above their household consumption." And accordingly "men whose wages are 18s. a-week, really make their place worth 30s. by this mode of dishonesty." We commend this grievance to the attention of such of our readers as are heads of families.

School Chemistry. By Robert Dundas Thomson, M.D., &c. Pp. 264. Longman and Co.

We have too long left unnoticed the new edition of this manual. A large portion has been re-written and re-cast, and we observe that most of the new facts of chemistry have been incorporated in the text. Considering the class for whom this book is written, it is full and compendious; in fact, here and there we observe a tendency to go beyond scholastic and Civil Service requirements,—for example, we hardly expect to find in such a work a chapter on Urinary Calculi. However, better too full than too meagre. It is one of the best school-books on chemistry.

NOTICES OF PATENTS.

1830. *Lubricators.* R. Thatcher, Oldham. Dated July 20, 1861.

The first part of this patent claim refers to a mode of lubricating revolving shafts, spindles, or other moving parts of machinery by the adaptation of a sponge, roll of flannel, or similar absorbent material holding a supply of the oil, and giving it out gradually to the surfaces requiring lubrication.

1845. *Materials for Lubricating Parts of Machinery.* N. E. Dumesnil. Rouen, France. Dated July 23, 1861.

This invention consists in adding a suitable proportion of animal or vegetable mucilage (such as linseed, &c.) to the soap-water commonly used for lubricating machinery. This addition may either be subsequent to the manufacture of the soap, or the mucilaginous substance may be dissolved in the alkaline lye previously to its being boiled with the fatty matter.

1856. *Preparation and Clarification of the Saccharine Matters Obtained from Beet-root, Sugar-cane, Indian Millet, &c.* W. E. Gedge, Wellington Street, Strand, London. A communication. Dated July 24, 1861. (Not proceeded with.)

The chemical process herein recommended for the clarification of sugar juice is intended to replace the treatment with animal charcoal (bone black) in common use. It consists in adding precipitated alumina, which by its affinity for the colouring matters effectually removes them from solution, and the syrup so partially purified is then treated with basic acetate of lead to separate the glutinous matters.

It does not appear that any special precautions were to be adopted in order to guard against the introduction of an excess of the lead-salt, or means employed for the separation of the last traces of this poisonous metal from the refined product. However successfully the principle may have been worked out in the hands of the inventor,

the public will always be distrustful of any scheme like this and the one formerly proposed by Dr. Scoffern, which is fraught with such dangerous consequences in the event of any oversight occurring in the course of operating upon a manufacturing scale.

1863. *Manufacture of Iron.* W. Longmaid. Inver, Galway, Ireland. Dated July 24, 1861.

With the object of improving the quality of wrought iron, the inventor introduces minute proportions either of silver, copper, nickel, or tin, or compounds of these metals, during the refining or puddling process.

The introduction of copper is generally supposed to be prejudicial to the quality of the iron; but with regard to silver, if the claim of novelty can be supported, an opposite conclusion is derived from the experimental results of Faraday and Stoddart. The addition of a small quantity of nickel is said to improve the character of the iron and to increase its tenacity.

1836. *Compositions to be Used in the Manufacture of Soap.* C. N. Kottula, Holborn, London. Dated July 22, 1861.

These new compositions are prepared by adding alum to the soda ash or caustic soda lye used for saponifying the fatty matters in the manufacture of soap.

The addition of a small quantity of alum may not be prejudicial, as it would probably assist in the removal of the highly coloured and grosser impurities, and, consequently, produce a superior quality of soap. Beyond this slight amount, however, the advantage to the consumer cannot be more profitable than in the case of china clay being used, or either beeswax or resin, as formerly patented by Mr. Kottula.*

1869. *Extracting Copper from its Ores.* E. Haeffely. Kearsley, Lancashire. Dated July 25, 1861.

These improvements relate, firstly, to the extraction of copper from its ores and products by an inexpensive menstruum, and this part of the invention is applicable chiefly to the pyrites ores containing a small quantity of copper which have been used in the manufacture of sulphuric acid. The patentee employs for this purpose the crude acid liquor discharged from retorts in which chlorine has been generated. Secondly, the improvements relate to an economical method of effecting the precipitation of copper from its solution by the use of the refuse of alkali works, known as "vat waste."

The mode of treatment described appears well adapted for the extraction of small quantities of copper from the class of ores referred to in the specification.

1822. *Improvements in the Production of Paper Pulp, and in Bleaching Paper Pulp and certain Fabrics, also in Apparatus for Cutting Wood.* M. Henry, Fleet Street, London. A communication. Dated July 19, 1861.

This specification describes a mode of manufacturing a rough kind of pulp, suitable for paper-making, from sawdust, wood shavings, or other forms of finely divided refuse of wood, or of the bark of certain trees and shrubs. The treatment adopted is intended to separate the succulent portion and colouring matters from the wood or bark, leaving the ligneous fibres in such a state that after bleaching they are applicable to the purposes of paper-making.

On several previous occasions† we have noticed practical suggestions which have had a similar object in view; it appears far from certain, however, whether the quality of the pulp from wood, particularly in regard to length and fineness of staple, will satisfy the requirements of the paper-maker.

* Chemical News, vol. iv. p. 316.

† Chemical News, vol. iv. pp. 134, 213, 224. *Ibid.*, vol. v. p. 335.

1831. *Gunpowder.* T. Roberts and J. Dale, Manchester. Dated July 20, 1861. (Not proceeded with.)

With the object of adapting the nitrate of soda to the purpose of making gunpowder, the inventors propose to overcome its tendency to become moist by incorporating with this and the other ingredients a certain proportion of an efflorescent salt such as the sulphate of soda. The nitrate of potash may either be partially or entirely replaced by the corresponding salt of soda.

Such a suggestion as the foregoing could only be carried into effect in the preparation of a common blasting powder; the superior qualities of gunpowder, both for cannon and small arms, would suffer a twofold diminution in energy by admixture with an extraneous salt as much as by the substitution of the less sensitive soda-compound for the ordinary potash saltpetre.

Grants of Provisional Protection for Six Months.

1278. Alexander Prince, Trafalgar Square, Charing Cross, London, "A new composition for casting to represent marble."—A communication from Johann Philipp Weimar, Berlin, Prussia.—Petition recorded April 30, 1862.

2176. William Edward Newton, Chancery Lane, London, "Improvements in lubricating compounds."—A communication from Eli Emery Hendrick, New York, U.S. —Petition recorded July 31, 1862.

2426. William Hunt, Tipton, Staffordshire, "An improvement or improvements in the manufacture of muriate of ammonia."

2434. Charles Garton, Bristol, "An improved method of applying heat in the manufacture and refining of sugar, and in malting, hop drying, brewing, distilling, and vinegar making."

CORRESPONDENCE.

Artificial Tourmalines.

To the Editor of the Chemical News.

Sir,—In reply to your correspondent's inquiry relative to a method of forming "Herepath's Artificial Tourmaline," I beg to inform him that he will find the requisite information in the following extract from Bird and Brookes' "Natural Philosophy," page 503:—

"Dissolve 50 grains of disulphate of quinine in two fluid ounces of acetic acid, and two of proof spirit, warmed to 130° F., in a very wide-mouthed flask or glass beaker; then slowly add 50 drops of a mixture of 40 grains of iodine in an ounce of rectified spirit; agitate the mixture and then set it carefully aside for six hours, in an apartment maintained at a temperature of about 50° F. The utmost care must be taken to avoid any motion of the vessel; indeed, all accidental vibrations should be guarded against by suspending the vessel by a string, or by allowing it to rest on a mass of cotton wool. If, in six hours, the *large* laminæ of the salt have not formed, warm the fluid with a spirit-lamp, and when it has become clear, add a few drops of the solution of iodine in spirit. The large laminæ form on the top of the fluid, and should be removed carefully by gliding under one of them a circular piece of thin glass. The specimen should be drained by resting the edge of the glass on a piece of bibulous paper, but it must not be touched on account of its extreme fragility; if any small crystals adhere to its surface they must be washed off by pouring over it a few drops of watery solution of iodine. When dry the specimen should be placed for a few minutes under a bell-glass by the side of a watch-glass containing a few drops of tincture of iodine; and, lastly, a little very fluid Canada balsam should be dropped

on it, and a thin glass cover applied without heat. Specimens may thus be obtained of extreme thinness, and half an inch in diameter or even larger, possessing scarcely the slightest colour and yet completely polarising transmitted light."—I am, &c.

James W. Young.

Glasgow

MISCELLANEOUS.

Medals and Muddles.—Thallium.—The scientific world was startled from its propriety on the appearance of the Jury Awards, at finding that the discoverer of the new metal, thallium, was left without reward, while a young French chemist, who had only discovered a source of it, long after Mr. Crookes had done the same thing, had received a medal. On the matter being investigated, it was discovered that the clerk who had copied the Jury Report had somehow or other omitted Mr. Crookes' name, who had been after all awarded a medal, as he deserved. The blunder will, of course, be corrected in the second edition of the Awards; but what apologies or corrections can atone to Mr. Crookes for the pain and annoyance he must have suffered? While on this subject, we must confess that we were greatly surprised at M. Lamy having received a medal at all. M. Lamy, no doubt, deserves a great deal of credit for having found the same source of thallium as Mr. Crookes, but as his specimen was not exhibited in the building until the beginning of July, we submit that he has no more right to a medal than the discoverer of the next new metal. M. Lamy says that he discovered thallium last spring, not knowing of Mr. Crookes' previous discovery. He must be very backward in the current scientific literature of the day, not to have heard of the discovery of a new element, various acounts of which have been published in every scientific journal in Europe during the last twelve months. We greatly fear that M. Lamy has some very strong and very weak friends at court. We hear that Mr. Crookes has found a source for thallium, by means of which he will shortly be able to produce the metal in pounds instead of grains.—*The Chemist and Druggist.*

The Revised Jury Awards.—The revised list of the Awards of Jurors is not, we regret to state, a correct list. To what extent the errors exist we do not know; nor to whom such errors are due; but it appears probable that some one still remains responsible for an amount of blundering truly startling. We have not taken the trouble to search for errors, but a sufficient number come unsought to indicate the large crop which might be reaped by one seeking them. In the case of Mr. Savage, the award is given but the name is omitted. Mr. Tucker, of Trinidad, receives his award, but for an incorrectly described contribution. Mr. Cruger, of the same island, sends a fine collection of drugs, and receives an award for "141 good specimens of timber." Mr. Devinish sends timber, and is rewarded for "drugs." These errors all stand in the "revised list." These gentlemen all reside far away; the only advantage is the honour; but what honour would be for Mr. Mudd to receive a medal for an improvement in boot-jacks, when he had contributed photographic landscapes? Or for Mr. Williams to be rewarded for an automatic toasting-fork, when he had contributed portraits? Some of the revisions made are scarcely more satisfactory. Here is a flagrant case: Mr. Crookes, whose name is well known to photographers as a chemist and physicist of very great ability, recently discovered, by the aid of the spectroscope, a new element—thallium. His claim to the discovery was never doubted. He sends a specimen of the element, of some of its compounds, a drawing of its spectrum, full description, etc. These were in the Exhibition at the proper time, and duly shown and catalogued. This contribution was entirely ignored, unnoticed, unmentioned, whilst a French contributor, who sent a specimen two months after the building was opened, and did not even claim the discovery, received a medal "for the discovery of new and abundant sources of thallium." The discoverer of the element's very existence was unnoticed; whilst he who discovered that more of it was to be found was medalled!—*The Photographic News.*

M. Robin's Soirees.—Amongst the various exhibitions at present open in the Metropolis in which scientific agencies are employed for purposes of instruction or amusement, there are few which have given us more pleasure in visiting than the scientific *soirées* of M. Robin, the well known and deservedly famous "French wizard." The first part of the entertainment consists of a variety of astonishing feats and transformations, in which M. Robin shows himself to be not only a consummate master of the art of legerdemain, but also thoroughly well acquainted with the powerful resources which modern scientific discovery has placed at the disposal of those whose *forte* seems to be to astonish while they instruct. Electricity appears to be the conjurer's familar spirit, and many wonderful tricks are effected by means of a monster induction coil. If the entertainment consisted of nothing beyond this, a notice of it would scarcely have been appropriate for our pages; but, unlike the generality of professors of the black art, M. Robin, in the second part of his entertainment, throws magic on one side, and condescends to be governed by the ordinary laws which matter and force are supposed to obey. Briefly telling his audience that the induction coil has assisted in many of his previous ingenious deceptions, he brings the instrument on to the platform, and exhibits some of the extraordinary powers of this instrument. It is one of the largest—if not the largest—we have ever seen, containing no less than forty-eight miles of wire, and giving a spark twenty inches in length. Some of the experiments were very beautiful, and lost none of their attractiveness by being presented in a more artistic and elegant manner than is customary in a scientific lecture-room. Amongst these we may especially mention the imitations of the aurora borealis and the lightning cloud. We were, however, most pleased at witnessing the piercing of several thick pieces of glass by the spark; the greatest thickness of glass which this coil could pierce through is three and a-half inches, but the experiment is attended with considerable danger. The entertainment concludes with some dissolving views, illustrating the different scenes which may be supposed to have been successively presented on the earth's surface during the geological epochs, correct representations of the fossils dating from the period being shown beneath, whilst the animals themselves are seen above to be wandering about in all their preadamite ugliness. Several novel effects, illustrating moving water and volcanic eruptions, are introduced, which considerably heighten the illusion. Altogether, the entertainment is one which cannot fail to be interesting to all classes of visitors. The scientific man will see in M. Robin's experiments striking and instructive illustrations of mechanical and electrical appliances, whilst the general audience will be cheated into receiving a considerable amount of information under the impression that they are being merely astonished and amused.

ANSWERS TO CORRESPONDENTS.

New Blue Colour, Ceruleum.—H. L. L.—We cannot inform our correspondent where this colour is to be obtained.

Conversion of Grape into Cane Sugar.—A. Ashby.—No method has at present been found out, although hundreds of attempts have been made to effect the conversion.

W. Reid.—You will find no information so suitable for you as the lectures by Dr. Playfair and Professor Hofmann, lately reported in our pages. No special work on the subject has been published.

THE CHEMICAL NEWS.

VOL. VI. No. 148.—October 4, 1862.

THE PETROLEUM ACT.

ON the 1st of this month the "Act for the safe-keeping of petroleum" came into operation. From and after that date not more than forty gallons of petroleum may be kept within fifty yards of a dwelling-house, or of a building in which goods are stored, without a license from some local authority. Any petroleum kept in contravention of the Act will be forfeited, and the occupier of the place is subject to a penalty of 20*l.* a-day for each day during which the petroleum is kept in contravention of the Act.

The Act commences with a series of definitions, the first of which, and the only one interesting to chemists, is as follows:—

"Petroleum for the purposes of this Act shall include any product thereof that gives off an inflammable vapour at a temperature of less than one hundred degrees of Fahrenheit's thermometer."

It is difficult to account for the agitation which followed on the first importation of petroleum and its products, and eventually caused the passing of the Act we are considering. There are several articles in common use, and stored in or near dwelling-houses in larger quantities than forty gallons, but for which no legislative enactment has been passed to ensure the safe keeping. The fire insurance offices, we believe, first took the alarm, and refused to insure the oils at any price, even if "stored at the bottom of the Thames." It does not say much for the knowledge and discrimination displayed in the management of these offices, that at this very time they insured naphtha and spirits, which are possibly more dangerous than raw petroleum, and turpentine, which is, at least, equally as dangerous as the most dangerous of the petroleum oils, at rates varying from 4s. 6d. to 12s. 6d., according to the places at which they were warehoused—at the former rate, for example, if stored in the London Docks, and at the latter if warehoused at Fenning's Wharf. This resolution of the fire offices was the occasion of great inconvenience and considerable loss to the first importers of petroleum products, and much of the inconvenience will remain until the warehouses, specially constructed to receive them at the Victoria Docks and at Liverpool, are completed.

The vapour of naphtha, every one knows, is highly inflammable at the common temperature, that of rectified spirits is equally so, while proof spirits (rum and brandy) ignite on the surface at the same temperature, and when very slightly heated give off an inflammable vapour. Turpentine does not inflame on the surface at the common temperature, but it gives off an inflammable vapour just at 100° F., and the point of permanent ignition lies very near 105° F. It follows that turpentine is quite as dangerous as the most dangerous petroleum oil we have examined, the point of permanent ignition of which was exactly the same as that of turpentine. Spirits are less dangerous, perhaps, only because their flame is more easily extinguished. It follows, too, that every oil-shop or warehouse where more than forty gallons of turpentine or of varnishes are stored is as dangerous to the neighbourhood as one holding the same amount of petroleum oil, and quite as much requires an Act of Parliament to regulate the amount of its stock. It has pleased the Legislature, however, to single out petroleum and its products; and, as we have said, the Act to ensure the safe-keeping of these came into operation on the 1st of the present month. We foresee that many disputes may arise out of the definition we have quoted, for, simple as the experiment appears, it is hardly likely that two experimenters will agree exactly in determining the temperature at which an oil gives off inflammable vapour. The matter, however, is not of so much importance that people need be particular to one or two degrees.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by FRANK H. STORER *and* CHARLES W. ELIOT.*

(*Continued from page* 158.)

The chief authority upon which the existence of salts of the brown oxide of chromium is asserted, seems to be that of Brandenburg,† who obtained solutions of substances which his own experiments, rightly interpreted, prove to have been mixtures of chromic acid and salts of chromic oxide, but which he thought were salts of an imaginary higher oxide of chromium. There is no such thing as a salt of the brown oxide of chromium, for the reason that there is no such base.

It was the opinion of Döbereiner‡ that the substance produced by the calcination of the nitrate of chromic oxide was a chromate of chromic oxide, and not an oxide of chromium, and he referred to the same formula the substances formed by the reduction of chromic acid by paper, and by the digestion of chromic oxide with chromic acid.

Thomson§ prepared a brown precipitate, which he called brown oxide of chromium, by passing a stream of sulphurous acid through a solution of chromate or bichromate of potash. We have found, as did Berthier,‖ that no precipitate whatever is produced by passing sulphurous acid through bichromate of potash; but this is a point of no importance in this connection. Thomson washed the precipitate which he had obtained for two

* Read before the American Academy of Arts and Sciences.

† Schweigger's *Journ. für Ch. u. Phys.*, xiii. 287-289, and 299-304.

‡ *Ibid.*, xxii. 482 (1818).

§ *Phil. Trans.*, 1827, Part i. p. 186.

‖ *Ann. der Chim. u. Pharm.*, xlvi. 185 (1843).

months, and noticed the steady abstraction of chromic acid from the precipitate. He finally analysed the washed oxide (as he called it) and made it to be a very basic chromate corresponding to the formula $(Cr_2O_3)_6CrO_3$. His opinion of the effect produced by the ignition of the nitrate of chromic oxide we have already cited. Under the head of chromate of chromium he remarks that, when chromic oxide is dissolved in chromic acid and the solution evaporated, there remains a substance quite similar in appearance to the brown oxide of chromium. Again, he observed the precipitate produced by mixing chromate of potash with sesquichloride of chromium, and says of it that it is evidently composed of chromic acid and the green oxide of chromium. Guided by the analogy of chromium and iron, he prepared a chromate of iron by mixing chromate of potash with sesquichloride of iron; an analysis of the edulcorated brown precipitate led him to the formula $(Fe_2O_3)_5\,CrO_3$, and in the filtrate and wash-water he thought he found another less basic chromate corresponding to the formula $(Fe_2O_3)_5\,(CrO_3)_{2\cdot5}$. On the whole, Thomson seems to have believed in the existence of a brown oxide of chromium, intermediate between chromic oxide and chromic acid; but every one of his experiments and analyses points directly to the conclusion, that the supposed oxide is in reality a chromate of chromic oxide, or rather, in most cases, an indeterminate mixture of chromic oxide and chromic acid.

We come now to the researches of Maus,¶ contemporaneous with those of Thomson, but much more conclusive upon the disputed point as to the existence of a distinct oxide of chromium answering to the formula CrO_2. Maus mixed an aqueous solution of sesquichloride of chromium with chromate of potash, and digested the washed precipitate with acetate of lead, thereby obtaining a green solution of acetate of chromic oxide and a yellow precipitate of chromate of lead; he treated the same substance with arsenic acid, and obtained the insoluble arseniate of chromic oxide and chromic acid in solution. By washing the original precipitate for three weeks he claims to have removed all the chromic acid, and says that nothing but chromic oxide remained. By mixing sesquichloride of iron with chromate of potash he prepared a similar chromate of iron, from which all the chromic acid could be removed by washing in the same way. He believed that the calcination of the nitrate of chromic oxide produced a chromate of chromium, but containing always nitric acid, because a heat sufficient to drive off all the nitric acid also converted the chromate of chromium into chromic oxide. Maus did not analyse quantitatively any of these precipitates, probably because he was embarrassed by the impurities from which he could not free the precipitates without altering their composition; but his qualitative results are amply sufficient to prove that they all contained chromic acid as part of their original constitution. Maus did analyse two substances prepared by digesting chromic oxide and ferric oxide in chromic acid; the results of these analyses were,—

1.	2.
Cr_2O_3=27·79 per cent.	Fe_2O_3=25·06 per cent.
CrO_3 =72.21 ,,	CrO_3 =74·94 ,,

And he assigned to them the formulæ $Cr_2O_3\,2\,CrO_3$ and $Fe_2O_3\,2\,CrO_3$ respectively. These formulæ are incorrect; the figures of the first analysis would give about four equivalents of acid to one of the oxide, and those of the second analysis would give more than four equivalents of chromic acid to one of ferric oxide. Both substances were unquestionably indeterminate mixtures. Dumas, recounting the experiments of Maus, says: "These results would be decisive, but they are contested by Berzelius."** It is therefore necessary to review the opinions of Berzelius on this subject.

In 1814 Berzelius, writing an essay on the "Cause of Chemical Proportions,"†† mentions the new oxide of chromium, prepared by Vauquelin, intermediate between the green oxide and chromic acid. Berzelius prepared this oxide, as he supposed, by igniting the nitrate of chromic oxide, observed the external properties of the substance, but did not analyse it, and made use of it only as an aid in establishing the contents of oxygen in chromic acid. In this essay he states the formulæ of the oxides of chromium as CrO_3, CrO_4, and CrO_6, the last being the acid. In a subsequent paper,‡‡ in speaking of the oxides of chromium, he lays special stress upon the close relation between manganese and chromium, and on the isomorphism of the sesquioxides of aluminum, chromium, manganese, and iron. He now writes the formula of chromic oxide as Cr_2O_3, and in all probability the peroxide of manganese (MnO_2) was in his mind an argument for the oxide CrO_2, though he does not mention it in the paper referred to. Finally, in 1829, Berzelius§§ rejects the conclusions arrived at by Maus, and gives the following reasons for his continued belief in the existence of the oxide CrO_2:—The first reason urged is the analogy between the sulphur acids and the oxides of chromium; this comparison is based merely on the isomorphism of chromic and sulphuric acids. In the light of the better knowledge both of the sulphur acids and of the oxides of chromium which thirty years have given us, and with the clearer notions of chemical classification which now prevail, we can find in the existence of sulphurous acid no argument for the existence of an oxide of chromium containing two atoms of oxygen. Secondly, Berzelius gives his own idea of the reaction consequent upon mixing chromate of potash with sesquichloride of chromium, which he thinks is not correctly described by Maus; according to Berzelius, the decomposition between these two salts does not take place at once, but the mixed solution first becomes dark yellow, soon changes to brown, a brown precipitate separates, and the liquid remains brown; hence he infers the formation of two compounds of chromium and oxygen, one soluble, and represented by the formula Cr_2O_5, the other the insoluble, CrO_2. We have accurately described in the first sentences of this paper the phenomena presented on mixing a solution of sesquichloride of chromium with a solution of chromate of potash, and have subsequently given the formula which represents the reaction. There is no reason to suppose that any such compound as Cr_2O_5 remains in solution; when the brown precipitate first formed has completely subsided, the colour of the filtrate is that of bichromate of potash. Lastly, Berzelius accounts for the fact, that the supposed oxide yields to analysis chromic acid and chromic oxide, by imagining that the original oxide is decomposed by contact with water into chromic acid and chromic oxide, as hyposulphurous acid is decomposed by water into sulphurous acid and sulphur, or as nitrous acid is resolved by water above 0° into nitric oxide and a solution of nitric acid—

$$(3\,NO_3 + Aq = 2\,NO_2 + NO_5 + Aq.)$$

¶ *Pogg. Ann.*, ix. 127 (1827).

** *Traité de Chimie Appliq.* (Liége, 1848), vii. 319.

†† Thomson's *Ann. Phil.*, iii. 104 (1814), and Schweigger's *Journ. für Ch. u. Phys.*, xxii. 56.

‡‡ *Pogg. Ann.*, vii. 415 (1826).

§§ In his *Jahresbericht*, viii. 123.

This might perhaps be a possible supposition, if the brown substance in question were prepared by methods in which water had no part; but when we see it precipitated from dilute solutions of monochromate of potash and a neutral chrome salt, or subsiding in the course of days from a very dilute solution of bichromate of potash, we are forced to the conclusion that the substance is from the first composed of the chromic acid and chromic oxide which analysis shows it to contain. In short, we have all the evidence, analytical and synthetical, that this brown precipitate is a chromate of chromic oxide, which we have of the real constitution of sulphate of potash.

The compound is well worthy the attention of those chemists who deny that formulæ ever express the actual constitution of bodies; it seems questionable whether any formula for the chromate of chromium can readily be written on the unitary theory which will express its properties and reactions as well as the dualistic formula. When at this distance we look back at the feebleness of the theoretical arguments which Berzelius opposed to the facts of Maus, Thomson, Döbereiner, and others, we marvel at the weight of a name whose authority outweighed the accumulated evidence of several trustworthy observers, and prevented the truth from prevailing thirty-four years ago. Berzelius himself became much less confident in after years of the truth of his earlier views; in his *Traité de Chimie*, ii. 307 (Paris, 1846), he calls the precipitate formed by mixing a neutral chrome salt with chromate of potash, chromate of chromic oxide, and in a subsequent paragraph merely says that it is very possible that this compound is the oxide of chromium, CrO_2.

An observation made by Rammelsberg|||| added something to our knowledge of the precipitate formed by mixing a solution of chrome alum with a solution of chromate of potash. He made a determination of the water contained in the washed precipitate, and weighed the chromic oxide obtained by igniting it; the oxygen which was expelled by ignition was determined by loss. The analysis led to the formula $(Cr_2O_3)_3(CrO_3)_2 + 9\,HO$, showing that the washing of the precipitate had been sufficient to make it somewhat basic. The point specially noticeable in Rammelsberg's statement is his assertion that the precipitate was washed till it imparted no colour to cold water. This is not credible, for the testimony of all other chemists is unanimous upon the point, that there is no limit to the removal of chromic acid by washing from this precipitate. We have often prepared much more basic precipitates, and have never yet seen colourless wash-water from the most basic of them. The colour may become so pale as not to be very noticeable in small vessels.

The discussion which we have traced left the subject in such doubt and obscurity, that most writers of textbooks have given both views of the substance in question, some leaning to one theory of its composition, some to the other. In our endeavour to settle the question, we shall next bring to bear upon the subject the arguments to be drawn from analogy.

(To be continued.)

On the Action of Selenic Acid on Alcohol, by M. Chr. Fabian.

By evaporating a weak solution of selenic acid, and raising the temperature to 265°, an acid is obtained containing about 83 per cent. of anhydrous selenic acid. In presence of concentrated sulphuric acid *in vacuo*, the density of the acid can be raised to 85 per cent. of anhydrous acid. Monohydrated acid contains 87·7 per cent. of it.

Selenic acid, concentrated *in vacuo*, and put in contact with its weight of absolute alcohol, becomes strongly heated. By raising the temperature ether is distilled, and at 160° C. reaction occurs; and the apparatus becomes filled with a dark green gas which condenses into white prisms of selenious acid. The other products of this reaction are formic acid, carbonic acid, oxide of carbon, aldehyde, and a small quantity of acetic acid.

Ethylselenic acid is obtained by heating for a certain time at 100° C. equal parts of selenic acid, alcohol, and diluting with an equal quantity of water, saturating with carbonate of lead, filtering, evaporating to one-half, *in vacuo*, and precipitating the lead by selenic acid, and then by sulphuretted hydrogen. The ethylselenic acid obtained in this way cannot be concentrated without decomposition. Left to itself, it rapidly separates into selenic acid and alcohol.

Ethylseleniates are also unstable. They are all very soluble in water, less so in alcohol, and insoluble in ether. They are isomorphous with the corresponding ethylsulphates, with which, mixed in every proportion, they crystallise.

The author has prepared salts of potash, baryta, strontia, lime, lead, copper, and silver.—*Annalen der Chemie und Pharmacie* (Supplementary vol.), vol. i. p. 241. 1861.

|||| *Pogg. Ann.*, lxviii. 274 (1846).

On the Separation of Iodine Combined with Metals, by M. Luchs.

The author has tried to extract the iodine remaining in the salts of the mother-waters used in the preparation of iodides. He has obtained satisfactory results by treating the solution with bichromate of potash and sulphuric acid by the following reaction:—

$$3KI + KO\,2CrO_3 + 7SO_3 = I_3 + Cr_2O_3\,3SO_3 + 4KOSO_3.$$

He recommends the following proportions for the operation:—25 parts of salts obtained from mother-waters, dissolved in 50 parts of water; then add 24 parts of ordinary sulphuric acid and 7 parts of bichromate of potash. After violent shaking the greater part of the iodine is precipitated in large crystals. The supernatant liquid is evaporated to dryness and distilled in order to collect the last traces of iodine. The iodine obtained in this way is not sufficiently pure, and must therefore be washed in water and again distilled, which, according to the author, is effected with the greatest ease in an ordinary retort heated by steam. — *Polytechnisches Centralblatt.*

TECHNICAL CHEMISTRY.

On the Manufacture of Caustic Soda, by* A. Norman Tate, *F.C.S.*

The manufacture of caustic soda, although at present quite in its infancy, will, I believe, soon become one of very great importance. To a great extent the use of caustic soda will supersede that of soda ash, especially for soap making, as it will not only lessen the amount of labour, but will also materially reduce the amount of apparatus required, thereby considerably lessening the

* From the *Pharmaceutical Journal*, having been read at the meetin of the Liverpool Chemists' Association, held May 15, 1862.

cost of plant, and also economising space,—two very important considerations to the manufacturer.

I am well aware that, as was the case with soda ash, there are some difficulties to be surmounted before caustic soda becomes so generally used for soap making and other purposes as soda ash now is, and not the least of these is the prejudice of manufacturers. In the case of soda ash the prejudice against its use was at first so great, that Mr. J. Muspratt had to give away tons of it before he could get the soap makers to employ it instead of the barilla, or kelp, which they were in the habit of using before the introduction of artificial soda.

I do not, however, anticipate quite so great an opposition to caustic soda, for, thanks to the diffusion of scientific knowledge, the manufacturers of the present day are to a great extent a different class of men to those of only a few years since, and we can now point to many of them who are eminent for their scientific attainments; and these scientific manufacturers—men who combine a knowledge of science with practical skill—cannot fail to see the great advantage caustic soda has over soda ash, and it will therefore come rapidly into use; indeed, the consumption of this article increases daily.

Processes for Manufacturing Caustic Soda.—There are at present two or three processes employed for the production of caustic soda, and I shall now proceed to describe them.

In the manufacture of soda ash, or carbonate of soda, by Leblanc's process, there is found in the liquors produced by lixiviating the black ash a certain amount of caustic soda, or hydrate of soda, mixed principally with carbonate of soda. In evaporating these liquors the carbonate of soda separates, and there remains a liquor containing nearly all the hydrate of soda. This liquor is technically known as "red liquor," owing to its being of a deep red colour from the presence of a deep red compound of sulphide of sodium and sulphide of iron. It was formerly, and is indeed even now in some works, the practice to carbonate this caustic liquor and evaporate it with the other liquors to make soda ash, and in some cases this answers well; but when the soda ash is used for soap making, the practice appears rather anomalous, inasmuch as the carbonate of soda of the ash must again be reconverted into the caustic state.

In 1853 Mr. William Gossage, of Widness Dock, near Warrington, whose numerous discoveries and improvements in the alkali manufacture have largely contributed to raise it to its present important position, took out a patent for using this red liquor for the production of solid caustic soda; and I believe I am right in stating that the greater portion of the caustic soda now used is made from red liquor.

Mr. Gossage's Patent.—The following is a brief outline of the patent of Mr. Gossage, which includes the caustic soda process. He first of all oxidises the sulphide of sodium of the black ash liquors by bringing them in contact with atmospheric air in a tower filled with pieces of coke; the liquors trickle slowly down through the coke, whilst a current of air is caused to pass up. By the action of the oxygen of the air, the sulphide of sodium of the liquors is oxidised, and the sulphide of iron before held in solution is thus set free and precipitated. He next adds a small portion of chloride of lime, to oxidise any hyposulphite. The liquor is then concentrated, to obtain salts or carbonate of soda. These salts are washed either with water or a solution of carbonate of soda, and are then drained and roasted in the ordinary manner, to form soda ash. The mother liquors from which the salts have separated are concentrated until they have a specific gravity of 1·45, and by this time nearly all the carbonate of soda and any ferrocyanide of sodium that may have been present have precipitated. After being allowed to settle, the liquor is drawn off and concentrated, to form solid caustic soda. The patent includes a process for the separation of the ferrocyanide of sodium from the carbonate of soda, and obtaining both salts free from admixture. I need not here describe the process for separating the ferrocyanide. There is also included an improved method for concentrating liquors by exposing them in thin films to the action of heated air.

I now proceed to describe the process as at present generally employed for the production of solid caustic soda without the use of lime,—*i.e.*, from the red liquor.

Manufacture of Caustic Soda from Red Liquor.—The liquors obtained by lixiviating black ash are concentrated by any of the methods usually employed, until the greater portion of the carbonate of soda has separated. The mother liquors thus obtained are the red liquors. They have a sp. gr. of about 1·30, and contain principally hydrate of soda. Besides this, however, there exists in them some quantity of carbonate of soda, a deep red compound of sulphide of sodium and sulphide of iron, some sulphate of soda and chloride of sodium, a small amount of ferrocyanide of sodium, and a minute quantity of some other compounds. These red liquors are mixed with a small quantity of chloride of lime, and placed in a pan generally known by the name of a fishing or boat pan, so called from its shape. In some works the bleaching powder is not added quite so early in the process.

This pan is made of quarter-inch wrought iron plates riveted together. It has a length of about 30 feet and a width of about 8 feet; the sides are sloping, so as to facilitate the collection of salts; but the greatest depth does not exceed 2 feet 6 inches. The pan is set in brickwork and heated by a fire underneath it, the flues from the fireplace passing directly under the entire length of the sloping sides of the pan. There are several methods of setting these boat-pans and in the arrangement of the fireplace and flues, nearly every works having a distinct plan of its own.

The invention of this pan, which is largely adopted in alkali manufactories, is due to Mr. David Gamble, of St. Helen's. In this pan the liquor is concentrated by boiling it until it has a specific gravity of 1·40, and a temperature of from 260° to 270° Fahr. Some nitrate of soda is added to the liquor whilst in this pan. During the concentration salts separate, which are fished out by means of a perforated spade. When the liquor has obtained the sp. gr. and temperature I have mentioned, it is run out into a vessel called the cooler or settler, and there allowed to remain some little time in order that salts may deposit. By cooling the liquor deposits salts which at a high temperature are held in solution. Some manufacturers allow the liquors to settle some time in the boat-pan, but this I consider to be a bad plan, as the pan may then be said to be doing no work; but if the liquors are at once run off when sufficiently strong, the pan may again be filled up, and the boiling of other liquors commence.

The boat-pans very frequently require repairs, which is a serious annoyance to the manufacturer. The principal reason for this is, that the salts sometimes adhere to the sides of the pan, notwithstanding the most careful attention on the part of the workman. Where the salts thus adhere the pan becomes much hotter in that part, and presently when the liquor penetrates through

this crust of salts the pan is suddenly cooled, and the unequal expansion and contraction of the plates injures it severely. This is not the only reason, for the caustic soda liquors appear to act upon the iron of the pan, and thus injure it, especially where the plates are riveted together. I shall allude to this action of the liquors upon iron again presently.

The salts which fall in the boat-pan and settler consist principally of carbonate of soda, mixed with some sulphate of soda, and also with a small quantity of chloride and ferrocyanide of sodium. They are sometimes converted into soda ash, but more frequently are dissolved, the carbonate converted into caustic soda by means of lime, and then added to the red liquors. The liquor, when properly settled, is run out into another vessel. This vessel is a hemispherical cast-iron pot, which at the top has a diameter of about 5 feet; to the top of the pot is fitted a cast iron ring, which is about 2½ feet high; and the greatest depth of the vessel, including the ring, is from 5 feet to 5 feet 6 inches. It is set in brickwork, and heated either by a fire underneath it, which plays directly upon the rounded bottom of the pot, or it is heated by the waste heat from another pot of the same description which is used in the finishing process.

To the liquor in this pot more nitrate of soda is added, and the whole boiled together for some time (from 12 to 24 hours, according to circumstances); more salts separate, which are fished out by the workmen; the liquor is also allowed to settle some time.

When salts cease to fall the liquor is placed in another pot called the finisher or finishing pot, which is similar to the one last described, but is always heated by its own fire. In this pot the liquor is boiled until it contains upwards of 60° of soda. More nitre is thrown into this pot. During the boiling a thick scum appears upon the surface of the liquor, which is carefully skimmed off by the workman; and when the contents of the pot possess the desired per-centage of soda, the fire is slackened or entirely withdrawn, and the liquor, after being allowed to settle a short time, is run off into iron casks, where, as it becomes cold, it assumes the solid form, and is then ready for removal from the works.

The process for the manufacture of caustic soda from red liquor differs slightly in minor details in different works, but in all principal points it is conducted in the manner I have just described.

I have not in this short sketch alluded to the changes which the liquid undergoes, for I think it better to mention them after describing another process for the manufacture of caustic soda, which necessitates the use of lime.

Preparations of Caustic Soda from Black Ash and Soda Ash.—In this process either black ash or soda ash is used as the source of the soda. The liquors obtained by lixiviating black ash are diluted with water until they have a sp. gr. of from 1·09 to 1·12; or if soda ash is used, it is dissolved in water until the solution has the specific gravity. The liquor is then agitated with lime, in order to convert the carbonate of soda into hydrate of soda:—

$$NaOCO_2 + CaOHO = NaOHO + CaOCO_2.$$

If the specific gravity is higher than 1·10, the causticising is not complete, as some carbonate of soda remains in the liquor. Even on a small scale in the laboratory this is the case; and it is decidedly preferable not to have the specific gravity of the liquor higher than 1·09.

The vessels in which the liquors and lime are agitated together are usually made of a portion of an ordinary cylindrical boiler. The boiler is generally cut in half lengthways. Fitted in this vessel is an agitator made of iron, and somewhat similar in form to the agitator of an ordinary butter-churn. When at work it is kept revolving by means of steam power. The vessel is filled to a certain height with liquor, and milk of lime or caustic lime in lumps is then mixed with it, and the mixture agitated until the decomposition is complete. It is decidedly the best plan to use milk of lime rather than lump lime, as the process of agitating the mixture requires much less time. The milk of lime should be made in a separate vessel, and from it run into the causticising pan. With milk of lime the decomposition may be completed in about half an hour: and the liquor is then run into large iron settlers, and there allowed to remain until all the lime mud has deposited.

Treatment of Lime Mud.—Before describing the process for concentrating the liquors, I will first dispose of this lime mud. After the liquor has been run off, the mud is washed, in order to free it as much as possible from any soda which may be mixed with it.

This washing is effected in two or three ways. One method is to agitate it with water in a vessel similar to the causticising pan, or else to agitate it by manual labour with a wooden pole or iron plunger. When the lime and water have been sufficiently agitated together, the mixture is allowed to stand, so that the lime mud may settle to the bottom of the vessel. This settling may either take place in the washing vessel or in a settler set apart for the purpose. The clear liquor or washing, which contains any soda that may have been dissolved, is run off and used either for dissolving more soda ash or for diluting fresh black ash liquor, as the case may be. The lime mud is run out of the settler into a heap to dry.

Another method employed is to run the mixture of lime mud and washings on to a filter. The filter is a large iron vessel fitted with a perforated false bottom. Upon this false bottom is placed first of all a layer of coke, above this a layer of pebbles, and on this again a layer of sand.

The washings are either allowed to drain slowly through the filter, or the process is hastened by producing a vacuum by connecting the lower part of the filter with a large air-pump, and then exhausting the air, or by injecting steam into the space at the bottom.

By producing a vacuum, the liquid is caused to pass through immediately. When all the liquid has passed through, fresh water is run on to the lime, and percolating through it washes out more of the soda; and this process is repeated until the mud is sufficiently free from soda. The lime is then thrown into a heap to dry, a tolerably warm place (such as a slip of ground immediately over a flue) being selected for the drying place.

The lime mud, when sufficiently dry, is used instead of limestone in the manufacture of black ash.

Composition of the Lime Deposit.—By the most careful washing it has not, I believe, been found practicable to entirely free the lime from soda. Although the last washings passing away from it may not contain any soda whatever, yet if the washed lime is subjected to a dull red heat sufficient to expel the carbonic acid, and the mud then washed with water, more soda may be extracted. Mr. Kynaston, formerly a pupil of Dr. Muspratt, and afterwards chemist at the works of Messrs. Muspratt, Brothers, and Huntley, of Flint, was, I think, the first to notice this, and he supposes that the soda is chemically combined with the lime. This is, I know, the

opinion of several chemists who have had to deal with the subject, and I certainly believe it to be so myself. Mr. Kynaston states that from 5 to 6 per cent. of soda remains after washing the undried mud. I have not found the amount quite so great. When the washing has been carefully performed on a small scale in the laboratory, I have never found more than 3 per cent., or less than $2\frac{1}{2}$ per cent.

This soda is of course found in the lime mud produced by the soap makers, and many of them send it away as refuse, or sell it at a very low price to persons who use it for mortar. By so doing they are losing a large quantity of soda. A year or two ago I examined some of this refuse from a soap works, and found it to contain $5\frac{1}{2}$ per cent. of soda; but this had been carelessly washed. Dr. Muspratt, in his "Dictionary of Chemistry," suggests that the soap manufacturer should first dry this lime deposit by exposure to the air, and then heat it, to expel carbonic acid. The lime, being thus converted into the caustic state, may be used to prepare fresh lye, and the soda which it contains would be thus saved. This process may be repeated until the lime becomes too highly charged with the impurities of the soda ash.

This suggestion is worthy the attention of the caustic soda makers, who may perhaps find it an advantage to use the same lime for causticising several quantities of liquor.

Concentration of Causticized Liquors.—I must now go back to the causticized liquor which I left in the settlers. This liquor is now to be concentrated. In some works (indeed, as far as I know, the practice is general) it is first placed in an iron boiler (an ordinary steam boiler), which may be closed in and fitted with safety-valves, pipes, &c., or an opening left for the escape of steam. In the former case the steam disengaged may be used as a motive power for working the machinery required in the works.

A patent has been taken out by Messrs. Roberts, Dale, and Co., of Warrington and Manchester, for the concentration of liquors in this manner and the employment of the steam disengaged.

The liquor is concentrated in the boiler until it has a specific gravity of 1·24 or 1·25 and a temperature of 230° F. It is then run into the boat-pan, and from that time the process is conducted in the same manner I have described when speaking of the red liquor caustic, except that in some instances the second concentrating vessel is not used, but the liquor is run from the boat-pan into the cooler, or settler, and from that direct into the finishing pot. When, however, soda ash is employed, it is not necessary to give so large an amount of settling, or to add any nitrate of soda, except in occasional instances.

Chemistry of the Process.—I will now describe the chemical changes which take place during the concentration. As I before mentioned, the red liquor contains hydrate of soda, carbonate of soda, sulphate of soda, chloride of sodium, sulphides of sodium and iron, together with some ferrocyanide of sodium and a small quantity of other compounds. The causticised black ash liquor also contains the same compounds. Both the red liquor and the causticised black ash liquor, as they become stronger by boiling in the boat-pan, deposit salts, which consist principally of carbonate of soda, some sulphate of soda, and a little ferrocyanide of sodium. When nitre is added to the liquor some of the sulphide of sodium is oxidised, and the sulphide of iron being at the same time converted into peroxide is precipitated with the salts, giving them a deep red colour. It is not well to add the nitre too soon in the boat-pan, as when it is added early, before the temperature is sufficiently high, some of it, instead of being decomposed, is deposited with the salts.

The oxidation of the sulphide proceeds slowly in the boat-pan, the sulphide being converted into sulphate and the nitrate into nitrate of soda. This is when the temperature is under 280° F., and as a rule the liquor in the boat-pan never reaches a higher temperature than 270° F.; but when, as is the case in the next vessel, the temperature is above 280° F. or 290° F., the decomposition proceeds much more rapidly, and ammonia is disengaged to a very large extent. Although some of this ammonia is without doubt derived from the decomposition of the cyanides, yet the quantity is so very great that the amount of cyanides present could not produce it all. It proceeds from the decomposition of the nitrate of soda; and, according to Dr. Pauli, of St. Helen's, who has given much attention to the subject, the change may be thus represented:—

$$2NaS + NaONO_5 + 4HO = 2NaOSO_3 + NaOHO + NH_3.$$

When the temperature rises above 310° F., as it does in the finishing pot, free nitrogen is also given off. This decomposition is explained by Dr. Pauli thus:—

$$5NaS + 4NaONO_5 + 4HO = 5NaOSO_3 + 4NaOHO + 4N.$$

This I believe to be a true explanation of the principal decompositions which take place; but it must be remembered that there are other compounds present, such as sulphites, hyposulphites, &c., and these also are decomposed. Dr. Muspratt represents the decomposition:—

$$2NaS + NaOS_2O_2 + NaONO_5 + 4HO = 4NaOSO_2 + NH_4O,$$

or

$$NaS + NaOS_2O_2 + NaOSO_2 + NaONO_5 + 4HO = 4NaOSO_3 + NH_4O.$$

The quantity of sulphide of sodium present in the liquor is, however, in greater proportion to the sulphites and hyposulphites than is represented in the equation; and there can be no doubt that hydrate of soda is also formed during the decomposition. It is rather a difficult matter to say with certainty what decomposition really does take place when there are so many compounds present. Probably the changes as represented both by Dr. Muspratt and Dr. Pauli take place, and others most likely also occur; but the explanation given by Dr. Pauli appears to me to represent the principal decomposition.

The iron also present in different forms is oxidised into peroxide, and unless separated would give the soda a very objectionable colour. Its separation is principally effected by settling in the pans and settlers. As the liquor becomes more dense the iron does not settle down readily, and is found to rise to the top of the liquid in the finishing-pot as a scum, which is skimmed off by the workman; and the caustic soda, when properly made, is almost white and comparatively free from iron. It however still contains some, which is sure to be the case, owing to the fact that peroxide of iron is soluble in caustic soda to a slight extent, although it is generally stated in chemical books that soda completely precipitates persalts of iron. By digesting precipitated peroxide of iron with solution of caustic soda, I have found the peroxide to be taken up in greater or less proportion according as the solution was stronger or weaker. When, however, the solutions were diluted with water, some of the peroxide was again precipitated, but there still remained dissolved permanently, even when the solution was extremely dilute, a small quantity of iron, equal to 1 part of peroxide to 7000 parts of soda.

There is more than this in much of the caustic soda of commerce, which is owing to the fact just mentioned,

that a concentrated solution of caustic soda takes up a larger quantity in proportion of peroxide of iron than is taken up by more dilute solutions.

I am inclined to believe that some of this is merely mechanically held, owing to the oxide being in a very finely divided state, and therefore very light; and the soda solutions being very dense, the oxide does not readily precipitate. As I mentioned just now, if the strong solution of soda is diluted with water, some of the peroxide is precipitated, and a similar result takes place when some of the caustic soda of commerce is dissolved in water. It may be that a strong solution of soda dissolves more peroxide of iron in proportion than a weaker solution, and that upon dilution the peroxide is precipitated, but I doubt it; for I have found that when concentrated caustic soda liquor, to all appearances clear and bright, is placed in a stoppered vessel, and allowed to stand for several days, the quantity of iron in it gradually decreases, and the bottom of the vessel becomes covered with a deposit of peroxide of iron. This appears to show that the iron is merely mechanically held in a very finely divided state, and by prolonged settling was deposited.

It has been suggested that the peroxide of iron during the boiling of the caustic liquor with nitre at a high temperature is by oxidation converted into ferric acid, and this uniting with soda forms ferrate of soda. At one time I was much disposed to doubt this, but lately I have made some experiments upon this point, and the results I have obtained leave me to believe that ferrate of soda is formed and does exist in solid caustic soda, but is decomposed upon dissolving it in water.

Some of the caustic soda sold has a very delicate blue or greenish tinge, which is, I believe, due to the presence of a trace of manganese.†

The quantity of nitre used varies considerably. For red-liquor caustic, from ¾ to 1½ cwt. is used per ton of caustic; for caustic soda made from black-ash liquor, about ½ cwt. per ton is employed; and when soda-ash is used it is seldom necessary to add any.

(To be continued.)

*The American Oil Wells.**

(*Concluded from page* 161.)

Crude petroleum is exported in large quantities from the oil regions to various places, where it is refined and rendered fit for common use. A large number of refineries are situated in the vicinity of New York, and other places far distant from the sources of supply. It is evident that all the refuse of the refinery is just so much extra expense involved in carrying the crude article, and it is reasonable to conclude, that if it were refined in the vicinity of the oil wells, where coal is abundant and cheap, a great saving would be effected. On the other hand, we must take into consideration the cost of transporting from the seaboard those chemicals used in refining. These chemicals principally consist of sulphuric acid and caustic soda. The acid is manufactured in various chemical establishments, and in the vicinity of New York, in large quantities at Bushwick, L. I., in the extensive chemical works of the Mayor of Brooklyn, Martin Kalbfleisch, Esq. A number of refineries have been erected in several of the villages in the oil regions. In distilling petroleum, a very light oil passes over at first, when the heat is low. This is the liquid commonly called benzine, and is the volatile dangerous fluid that has been the cause of so many explosions. It is a powerful solvent, and will dissolve resins and grease. The temperature of the still is subsequently raised, and the whole of the petroleum is distilled, leaving a residue of bitumen. The distilled product is afterwards agitated in a vessel with warm dilute sulphuric acid, is allowed to settle, then run off into another vessel, where it is washed with water. It is then agitated with caustic soda in solution, washed with water, and submitted to a second careful distillation, which finishes the operations. If these are carefully conducted, the oil obtained will be nearly as colourless as alcohol. Some specimens of petroleum are rendered very pure by one careful distillation. Various opinions exist among refiners respecting the kind of stills which should be used. Oils of different specific gravities are obtained from petroleum according to the temperatures to which it is subjected during distillation. That which passes over at a temperature of 302° Fah., according to the experiments of Professor B. Silliman, Junr., has a specific gravity of ·733 (three lower than sulphuric ether); that which has been obtained at 320° has a specific gravity of ·752; that at 338° Fah., ·766; at 392°, ·800; at 518°, ·854. Pure alcohol has a specific gravity of 8·15. As several eupion oils obtained from petroleum are lighter than alcohol, we can thus form a very correct idea of their volatile character.

We will close these articles by presenting some information relating to the explosive character of petroleum. Laws have lately been passed in New York, and also in London, prohibiting the storage of petroleum, except in buildings suitable for the purpose, and in situations where other property is not endangered. This is right; still several erroneous notions prevail in the community respecting this fluid, which deserve to be corrected. For example, some persons believe that if a match is brought into contact with this fluid in a barrel, the whole will explode like a keg of gunpowder. This is not the case. No hydrocarbon fluid will explode while in the liquid state. It must first be evaporated, then mixed with seven or eight volumes of atmospheric air before it will explode, when a lighted match is applied to it.

Several weeks since a committee of the Brooklyn City Common Council was appointed to search into the causes of a petroleum explosion which took place in Williamsburgh, L. I., and to collect information on the explosive nature of this fluid. They examined several witnesses, who gave their experience, which we present in substance, on account of its scientific value.

Professor Eaton, of New York, stated that petroleum is not liable to spontaneous combustion; that the light gas which evaporates from the crude material, on exposure to air, is vaporised naphtha; that no benzine proper is obtained from it; that the article called benzine, said to be distilled from it, is not true benzine, and that various oils obtained from petroleum have not been named by chemists.

Mr. Mowbray, a practical chemist, presented the following statement of the parts of crude petroleum:—

Naphtha, Benzine, or Benzol, technically "Light Ends"	15
Light oil, specific gravity 60° to 55°	12
Light illuminating oil, specific gravity 54° to 50°	10
Medium illuminating oil, specific gravity 49° to 46°	25
Heavier illuminating oil, specific gravity 45° to 40°	20
Heavy oil, precipitating paraffine, 1·3 when exposed to temperature of 40° Fahrenheit	12
Loss	6
Total	100

† Mr. Martin Murphy, assistant to Dr. Muspratt, states that he has proved this colour to be due to manganese, and supposes the manganese to be derived from the limestone used in making the black ash. He has found manganese in several samples of limestone which he has examined.

* From the *Scientific American*.

On the examination, Mr. L. B. Page made some experiments to show that oils should not be ranked dangerous according to their specific gravity. His apparatus consisted of a cup of water in which was inserted another cup of the capacity of three ounces. Into this the bulb of a thermometer was inserted, to indicate the degree of heat generated by a spirit lamp placed directly under the cup containing water. The first experiment was with refined oil, at 50° Baumé. When the thermometer indicated 118° the oil commenced to vaporise, so that it would catch fire from a lighted paper; but it was not until 124° had been reached that the oil itself would take fire when burning paper was applied. The second experiment was with refined oil, at 43, which took fire at 87°.

PHARMACY, TOXICOLOGY, &c.

The Action of Chromic Acid on Vegetable Alkaloids, by J. J. ANDRÉ.

HITHERTO, the behaviour of chromic acid with vegetable alkaloids has been but little studied; in the most complete chemical treatises only slight mention is made of the existence of chromates of berberine, cinchonine, and strychnine,—all three described in a few words, and all obtained by double decomposition.

When I began these researches I was not aware that these compounds were already known; but soon undeceived on this point, yet finding the subject had been studied in a very limited degree, I determined to continue my researches, and to publish any interesting facts I might find in the course of them.

My first experiments were made with commercial sulphate of quinine. Taking a certain quantity of this salt, facilitating its solution in water by a little diluted sulphuric acid, and adding chromic acid, bichromate or neutral chromate of potash, an abundant flaky yellow precipitate is formed, darker, and even of an orange-red colour in the case of chromic acid or bichromate should we use these last two reagents. If the mixture had been made in a balloon and had been heated, in the hope of dissolving and crystallising the precipitate, it contracts and agglomerates, taking the resinous appearance of quinine, and dehydrating rapidly. In spite of shaking the liquid and submitting it to a high temperature, a portion only was dissolved; the other portion adhered to the sides of the vessel, and was detached with difficulty, taking a yellowish or brown colour if the heat was not applied with great care. A partial reduction of the chromic acid then takes place; sesquioxide of chromium, the result of this reduction, is deposited, with a certain quantity of quinine, more or less altered. The filtered liquid deposits a layer of amorphous yellow matter similar to the preceding. After twenty-four hours, finding no trace of crystallisation in the precipitate, I looked upon this as a negative experiment, and believed I had only obtained one of those ill-defined combinations which it is extremely difficult to study and analyse. If I had more thoroughly examined the precipitate, formed at the moment of mixing, and after washing had carefully dried it, I should have found that though apparently amorphous, yet, when viewed through a lens, it was composed of fine, needle-like crystals. Afterwards, as we shall presently see, by employing more convenient proportions of sulphate of quinine and bichromate of potash, I was enabled to determine the production of a perfectly crystallised neutral chromate of quinine.

Preoccupied with the idea that chromic acid and bichromate of potash itself were agents too energetic to combine with alkaloids, I had recourse to a neutral chromate of potash, which immediately gave a satisfactory result, and I now never use chromic acid or bichromate of potash without taking steps to limit their action.

Basic Chromate of Quinine.—When to a solution of sulphate of quinine is added only the quantity of weak sulphuric acid strictly necessary to dissolve this salt,—an essential precaution,—and to this is poured neutral chromate of potash dissolved in water, the precipitate resulting from this mixture is susceptible of being entirely dissolved by heat if sufficient water is employed. After filtration, and while cooling, numerous crystals of a beautiful light yellow colour are deposited in tufts, like sulphate of quinine. This new salt is a basic chromate of quinine obtained by double decomposition.

I have stated that only just the quantity of weak sulphuric acid necessary to promote the solution of sulphate of quinine must be used; in fact, if the acid predominates, it converts part of the neutral chromate of potash into bichromate,—the reaction becomes complex, and the phenomena of reduction previously indicated appear. The surest way of avoiding this accident is to employ only basic sulphate of quinine. Take, for instance, 6 grammes of this salt, and dissolve them by the aid of heat in 800 grammes of distilled water; then add to this from 20 to 25 grammes of a solution of neutral chromate of potash prepared in ten times its weight of water. I have made use of this proportion in all my experiments with chromic acid and the two chromates of potash. Boil the mixture, shaking the balloon containing it from time to time, then filter, when the precipitate which had formed becomes dissolved. In proportion as the temperature diminishes, the liquid deposits an abundant crystallisation of basic chromate of quinine, which must be collected on a filter and washed freely until the water used ceases to precipitate nitrate of baryta by the addition of pure nitric acid. The crystals must then be dried on unsized paper, in the air, or in a stove heated to 30° C.

The same basic chromate, perfectly crystallised, but in smaller quantities, may be obtained at a somewhat low temperature by pouring into a solution of basic sulphate of quinine, in the proportion of 4 parts of this salt to 2·2 of water at 35°, 12 or 20 parts of neutral chromate of potash solution. The formation of basic chromate of quinine is almost instantaneous on the addition of 20 parts of neutral chromate of potash to the solution of sulphate, the crystalline precipitate being light, flaky, and of considerable volume; when, on the contrary, only 12 parts of neutral chromate are added, the precipitation is slow, the crystals not so abundant, but in longer needles. Collected after twenty-four hours, these crystals, although different in volume, give an equal weight of basic chromate of quinine.

When rapidly deposited from a slightly concentrated solution, basic chromate of quinine has the appearance, almost to a shade, of its corresponding sulphate; its very fine crystals are of a lemon-yellow colour; if, on the contrary, it is formed slowly and in a weaker solution, with the addition of no more chromate than is necessary for the double decomposition, the needles are longer,—more than five millimètres,—and are composed of long, bi-refracting prisms; their colour is nearer golden yellow than the others, and reflects the light more vividly. This difference seems to be owing to the way the crystals are grouped, and in no way affects their composition. A flaky, lemon-coloured chromate of quinine may be made

golden yellow by simply redissolving it in the proportion of 1 part of salt to 400 parts of boiling water,—it then yields only long needle-shaped crystals.

This salt is much less soluble in water than basic sulphate of quinine; its bitter flavour is more slowly developed; it requires, to dissolve it, 160 parts of boiling water and 2400 at 15° C., so that the mother-waters contain very little of it. Cold alcohol dissolves it without decomposition; it is insoluble in ether. It may be exposed without fear to the brightest sun, as light does not affect it. A solution of it in water undergoes no change on boiling; the salt it contains remains unaltered; but if a thin layer of this chromate is spread on one of Gay-Lussac's stoves, heated to 100°, it gradually decomposes, loses its golden-yellow colour, and takes a green-bronze tint, the shape of the crystals seeming to remain unchanged; while the temperature remains below 92° it undergoes no alteration, and loses no more than 2 per cent. of interposed water, and does not effloresce.

Basic chromate of quinine, dissolved in water, like all the alkaloid chromates of which we shall have to speak, precipitates, with metallic solutions, such as lead, mercury, silver, &c., insoluble chromates by double decomposition, the alkaloid combining with the acid of these bases reappears with all its characteristic properties.

By boiling a solution of basic chromate of quinine in a balloon with freshly precipitated and still moist hydrate of quinine, this chromate becomes superbasic, its colour fades slightly, and its crystalline form undergoes modification; the new combination deposits itself in small groups arranged like cauliflower-heads; observed through a lens, these productions greatly resemble the leaves of certain ferns, such as the *Asplenium adianthum nigrum*, or the *Asplenium ruta muraria*; in liquids more dilute they are developed into very elegant plumes.

The combination of basic chromate may be represented by $(C_{20}H_{12}NO_2)_2\,CrO_3$; unlike its corresponding sulphate, its crystals are anhydrous. In analysing this salt I used, in the first place, simple incineration,—a convenient and rapid process, which allows of the deduction from the sesquioxide of chromium found as an ultimate product the amount of chromic acid which should be united with the quinine; but the figures I obtained not always agreeing with those indicated by theory, I made use of double decomposition, effected by treating a nitrate of lead solution with the soluble chromate. Basic chromate of quinine is well adapted for this process, and the insoluble chromate of lead collected in the reaction, after being well dried, yields a quantity of chromic acid corresponding to the formula given above.

Neutral Chromate of Quinine.—Quinine enters into two combinations with chromic acid, as with sulphuric acid. A solution of bichromate of potash poured into a solution of sulphate of quinine, prepared cold and slightly acidulated, forms very soluble bisulphate of potash by double decomposition, and deposits neutral chromate of quinine. The precipitate is orange-yellow colour, and of cheesy appearance, and is composed, as we have said before, of very small needle-like crystals; but in the mass it looks amorphous. To produce this salt in well-defined crystals, I dissolved 8 parts of commercial sulphate of quinine in 600 parts of water containing a few drops of weak sulphuric acid. This solution I heated to about 60° C., adding 14 parts of solution of bichromate. The mixture being left undisturbed for three or four hours, beautiful tufts of neutral chromate of quinine are developed; at the end of twenty hours I threw the salt on a filter and carefully washed it, as it is much more soluble than basic chromate of quinine; then I dried it, screened from the light, in a stove heated to 30° C.

Prepared in this way, neutral chromate of quinine crystallises in long slender needles of a beautiful yellow-orange colour, reminding us of the silky lustre of asbestos.

When exposed to the sun it alters rapidly, and does not long resist even diffused light; it decomposes under the influence of heat, burning fiercely, which reaction commences between 60° and 65°. Its solution when boiled takes a brown colour, which gradually deepens; the same alteration occurs, but more slowly, on evaporating the mother-waters at a moderate temperature, to obtain a second crystallisation; in this case, a portion of the chromic acid seems to be reduced, a chromate of sesquioxide of chromium is formed, which blends with the neutral chromate of quinine, giving it a reddish brown colour; this effect is reproduced equally with all solutions of chromates of alkaloids, which are not basic. The decomposition takes place even at the ordinary atmospheric temperature. It not unfrequently happens that bubbles of oxygen gas are formed in these liquids, which adhere to the sides in considerable number, while the liquid becomes gradually coloured by the solution of the sesquioxide of chromium.

By treating hydrated and freshly precipitated quinine by a very weak solution of chromic acid, taking care to maintain it in suspension by constantly shaking the balloon containing the mixture, and by raising the temperature to 60° and not beyond, the quinine gradually disappears, giving place to the formation of neutral or basic chromate, according to whether the alkaloid is or is not in excess. Notwithstanding its destructive energy on organic matters, chromic acid then combines directly with alkaloids. This process being always liable to give mixtures of basic salts and neutral or acid salts, is not applicable to alkaloids, which can combine in several proportions with chromic acid; but when it can form only one combination, as with cinchonine, quinidine, and strychnine, there is no reason for not directly employing the acid, instead of producing double decomposition by bichromate of potash. A chromate obtained in this way, containing only a small excess of acid, is easily freed from it by a little distilled water, and then collected quite pure.

Neutral is much more soluble than basic chromate of quinine; I have determined its composition to be

$$C_{20}H_{12}NO_2,CrO_3,8HO,$$

by the same method I employed in analysing basic chromate, double decomposition by means of nitrate of lead. I have been able to appreciate the quantity of water only comparatively, neutral chromate of quinine not being able to support a temperature above 62 degrees.

(To be continued.)

Extract of Logwood a Deodoriser and Disinfectant.

M. T. P. Desmartir relates (*Comptes-Rendus*) that he has employed an ointment composed of equal parts of lard and extract of logwood with extraordinary success in removing the fetid odours, and bringing about a healthy action in sloughing and gangrenous wounds. It cures hospital gangrene, he says, like magic.

Portable Gas Lights.—Hollow metallic canes filled with condensed gas are now used in some continental cities. The bearer has only to turn a small nipple and apply his match, when he instantly finds himself furnished with a torch that will light him several hours.

INTERNATIONAL EXHIBITION.

Class I.

Mining, Quarrying, Metallurgy, and Mineral Products.

(*Continued from page 129.*)

The mineral riches of the British dependencies appear to rival those of the mother country. We have already mentioned gold, which is to be found in almost every colony we have established in the world. Happily, perhaps, for the future of most of these colonies, coal is almost as ubiquitous. The coals of India, which may exert a most important influence in developing the resources of that portion of our dominions, we have already noticed. No less important may the vast coal-fields of New South Wales be in maintaining the relations of Australia with the mother country. All our Australian colonies appear to contain coal; but the great fields of the Continent are in New South Wales, where coal is as abundant as in old South Wales. The colonists, however, have named their principal coal port Newcastle and not Cardiff. Every kind of the mineral is found in New South Wales, and specimens from all the principal mines are exhibited by Mr. Keene, inspector of coal fields to the colony (296). Some samples are also exhibited by mining companies. Mr. Keene's collection well illustrates the varieties and qualities of the coal, some of which the Exhibitor, in his report to the Lords of the Admiralty, declares to be equal, if not preferable for steam ships, to the best English coal as it is to be got in Sydney, *i.e.*, after having been twice transhipped.

The other parts of the continent of Australia are not so rich in coal. Victoria contains a little. There is a seam at Cape Patterson, but gold digging at present is too profitable for any one to think of coal mining. Lignite, too, is found at Ballarat, but this has not yet been worked. The more valuable form of carbon, the diamond, is said to have been found in the Ovens district, and people are making great preparations to wash for it.

Queensland has coal, a barrelful of which—apparently of very good quality—the visitor will see in that department. It does not appear to be abundant in that colony; but attention has not yet been much directed to it. Neither Western nor South Australia sends a specimen of coal.

Tasmania, however, appears to have vast fields of coal. In the collection of Mr. Gough (410—436) the visitor will remark specimens of different varieties from various parts of the colony; and here, too, will be seen the bituminous shale called Dysodile, an account of which was given by Mr. Church at page 122. Most of the Tasmanian coal appears to be bituminous; but anthracite is found on the south side of the island, and is said to be abundant.

Both Tasmanian coal and the coal of New South Wales we are glad to see are at present being tested by the Board of Admiralty, to ascertain their fitness for the use of our war steamers. There would seem to be little doubt of the experiments resulting in a favourable report. Mr. Keene, who appears to have thoroughly investigated the matter, gives an interesting account of the geology of these coals, the lower beds of which, he thinks, are older than any worked in Europe. The large collection exhibited by this gentleman shows conclusively the origin of these coals in the palæozoic, or true carboniferous system.

If we continue an imaginary voyage round the world, we can find coal at almost any British dependency we call at. New Zealand has coal, and in Auckland and Nelson large fields, both represented in the Exhibition. Vancouver's Island has coal, and sends a specimen. Canada sends no sample, and, perhaps, has no coal; but there are vast peat bogs, which will become valuable as fuel when wood becomes scarce. Nova Scotia, however, has most extensive coal fields, which might make up for any deficiency in Canada. Of our African dependencies Natal sends a small sample of coal.

NOTICES OF PATENTS.

1878. *Weighing Machine.* W. E. Gedge, Wellington Street, Strand, London. A communication. Dated July 27, 1861. (Not proceeded with.)

This apparatus depends for its action upon the circumstance, that pressure exerted upon the head of a column of water will cause the level of the fluid to rise in an adjacent and connected tube to a height which may become the measure of the weight or pressure applied. It is constructed somewhat like the piston and cylinder of a steam engine, the top of the piston rod having a plate affixed, upon which is rested the substance to be weighed; the displacement of water (or other fluid, such as spirits of wine, oil, or mercury) is observed, and the height of the column read off by the help of a graduated scale attached to the smaller perpendicular tube outside the cylinder.

The indications afforded by such an instrument would obviously be liable to error from several sources; a modification of the hydrometer itself would give more reliable results, but neither could compare with the expeditious modes of weighing in common use.

1892. *Preparing Medicinal Substances and Compounds from the Livers of Cod and other Salt-water Fish.* C. C. J. Guffroy, Lille, France. Dated July 29, 1861.

This invention has reference to the subject of a previous patent, dated July 20, 1860, and consists in a method of preparing new medicinal substances from the aqueous solutions remaining after the extraction of oil from the livers of cod and other fish.

1893. *Preparing Red, Purple, and certain other Dyes.* Wentworth L. Scott, Bayswater, London. Dated July 29, 1861.

This invention refers to the employment of dinitronaphthaline as the starting-point from which to produce red and purple dyes by processes of treatment similar to those which serve in the preparation of the same colours from aniline.

1910. *An Improved Lucifer Match and Prepared Paper for Lighting the Same.* H. Mearing, Great Randolph Street, Camden Town. Dated August 1, 1861. (Not proceeded with).

The directions given for the preparation of this match and a suitable friction surface are as follows:—The wooden splints are first dipped into melted sulphur, and then coated with a mixture of chlorate of potash, 8 parts, sulphur 1 part, rotten stone 4 parts, gum 2 parts, and lamp-black 1 part, with sufficient water added to form a paste. The paper for lighting the match is prepared by brushing over with a composition made from amorphous phosphorus, 4 parts, and powdered graphite 1 part, made into a paste by incorporating with a solution of 1 part of silicate of soda in 4 of water. The match cannot be ignited on any ordinary friction surface, but will be immediately inflamed on drawing briskly over the pre-

pared paper; by this means a greater security from accidental fire is ensured.

There can be do doubt regarding the advantages attending the use of this safety match: we have, in fact, already taken occasion to notice these improvements in the case of a similar invention, that of Messrs. Bryant and May, who appear to have forestalled Mr. Mearing by an earlier announcement of their mode of manufacture.

1915. *Smoke Consuming Furnaces.* J. Cook, East India Road, Poplar. Dated August 1, 1861. (Not proceeded with).

This invention consists in leading an aperture through the bridge of the furnace and terminating below the fire bars; then, by means of a valve, regulating the draught at pleasure, opening it wide for the free admission of air at the time of adding fuel, and closing the communication when the draught of air to the bridge is no longer needed.

There have been several suggestions for meeting the difficulty of consuming the smoke in furnaces by the admission of air to the bridge, some of which appear to have been carried out with very successful results.

1916. *Candle Moulds.* M. Pratt, Stafford. Dated August 1, 1861.

As a substitute for the ordinary pewter moulds the inventor proposes to manufacture candle moulds of glazed earthenware. He prepares a fine dry clay for this purpose, similar to that which is used for making encaustic tiles, door slabs, and other articles, and moulds it between metal dies under great pressure.

1928. *Glass Furnaces.* C. Schinz, Offenburg. Dated August 3, 1861.

The fire grate according to this invention forms part of a separate furnace which the patentee calls the "gas regenerator," and this grate, if burning coal, is fed through a hopper. For generating and aiding the combustion of the gases, he injects air by means of a fan-blast into the lower part of the furnace, and heated air likewise into the flue leading from the fire-grate, the supply of air being regulated so as to furnish the exact quantity necessary for the combustion of the fuel and burning gases. The furnace is made to correspond in shape with the form and disposition of the pots or crucibles, a limited space only being left between the sides of the pot and the walls of the furnace.

The construction of the gas-furnace patented by Mr. Siemens fulfils the same object as that described above, and is calculated to economise to the utmost the heat generated by the combustion of the fuel.

Notices to Proceed.

1278. Alexander Prince, Trafalgar Square, Charing Cross, London, "A new composition for casting to represent marble."—A communication from Johann Philipp Weimar, Berlin, Prussia."—Petition recorded April 30, 1862.

1332. Christopher Binks, Parliament Street, Westminster, "Improved methods of obtaining hydrogen gas and certain gaseous compounds of hydrogen and of carbon."

1385. Leo de la Peyrouse, Panton Square, London, "Improvements in treating neutral and acid fatty or oily substances, resins, and resinous substances, and compounds or products containing paraffin."—Petition recorded May 8, 1862.

1404. Robert Moore, Cannon Street West, London, "Improved apparatus for indicating the presence, position, or accumulation of liquids, gases, or vapours, and apparatus for preventing danger or damage consequent thereon."

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Purity of Frozen Water.—M. Robinet has made a variety of experiments to ascertain how far water is freed from saline impurities by congelation; and his results go to show that the small amount of lime and magnesian salts in potable waters is forced out in the act of freezing as completely as the more soluble salts present in sea-water. Frozen water, he says, is so far purified that it may, in most cases, be used for chemical purposes in place of distilled water. In reference to this, M. Martens adds, that in his photographic excursions among the Alps he found that he could always use the water from the glaciers instead of distilled water, but that dissolved snow did not answer.

Dr. Rüdorff has also made experiments on the freezing of saline solutions (*Bericht. d. Akad. der Wissensch. zu Berlin*, 1862, s. 163). He employed the platino-cyanide of magnesium, the solution of which is colourless; but he found that when the solution was frozen so far that the water left was not enough to hold the salt dissolved, crystals of the well-known beautiful appearance were formed. Other curious results were observed with a supersaturated solution of sulphate of soda. When such a solution was cooled below the freezing point and the formation of ice prevented, it was found that a piece of ice dropped in determined the formation of ice, while a crystal of the salt caused the formation of crystals of the salt. A very small piece of the salt dropped in with ice caused the separation of the whole of the salt. He noticed, too, that the lowering of the temperature produced an alteration in the constitution of the solution. For instance, when a solution of the blue salt, $CuCl + 12HO$, was frozen, the unfrozen water contained the green salt, $CuCl + 4HO$. Other curious results will be found in the paper referred to.

Crystals of Lead.—Stolba obtains lead crystals in a very simple way. (*Dingler's Polytech. Journ.*, bd. clxiv. s. 371.) He pours melted, but not overheated lead into a paper box—a pill-box would answer—and, as soon as the metal begins to solidify around the sides, pours away the metal which is still fluid. Experiments with tin, antimony, bismuth, cadmium, and zinc gave similar interesting results.

Solubility of Iodine in Sulphite of Ammonia.—Hesse recommends (*Annal. der Chem. und Pharm.* bd. cxxii. s. 225) the use of a solution of sulphite of ammonia in place of sulphurous acid for the estimation of iodine in commercial samples. Iodine dissolves quicker in this salt than in the acid.

II. ORGANIC CHEMISTRY.

Action of Iodide of Phosphorus on Glycerine Acid.—By acting on glycerine acid and a little water, with twice the weight of iodide of phosphorus, Beilstein obtained (*Annal. der Chem. und Pharm.* bd. cxx. s. 226) iodo-propionic acid. Purified by solution in hot water, this acid is procured as a white crystalline mass having a pearly lustre. It is but slightly soluble in cold water; fuses at 82°; is very soluble in alcohol and ether. The ether of this acid is easily prepared by saturating the alcoholic solution with hydrochloric acid gas, and digesting with water, whereupon an oily fluid (the ether in question) separates, which can be purified by agitating with carbonate of soda. The ether possesses a strongly aromatic odour, and appears to evaporate without decomposition. An aqueous solution of iodo-propionic acid is decomposed by oxide of silver. Iodide of silver is precipitated, and the silver salt of another acid is left in solution. When the silver is removed by sulphuretted hydrogen, and the solution evaporated in a water-bath, this second acid is obtained in acicular crystals, which are very soluble in water, the solution having a strong acid reaction. The author has not yet sufficiently

studied this acid to give a full account of it. He thinks it has probably the same composition as lactic acid, but is not identical with that acid.

MISCELLANEOUS.

THE AMERICAN TRADE IN PETROLEUM. *

Its existence in any vast amount appears to have been unknown until 1845, when a spring was "struck," while boring for salt, near Tarentum, thirty-five miles above Pittsburgh, on the Alleghany. Experiments having proved its constituents to be nearly the same as those of the artificial carbon oil, a company was organised in New York to attempt its purification by the same process applied to the latter. But little was effected, however; and in 1857 Messrs. Bowditch and Drake, of New Haven, commenced operations at Titusville on Oil Creek, where traces of early explorations were found, and in August, 1859, a fountain was reached by boring, at a depth of 71 feet, which yielded 400 gallons daily. Before the close of the year 1860, the number of wells and borings was estimated to be about 2000, of which 74 of the larger ones were producing daily, by the aid of pumps, an aggregate of 1165 barrels of crude oil, worth, at 20 cents a gallon, about $10,000. Wells were soon after sunk to depth of 500 or 600 feet, and the flow of petroleum became so profuse that no less than 3000 barrels were obtained in a day from a single well, the less productive ones yielding from 15 to 20 barrels per diem. In several instances extraordinary means were found necessary to check and control the flow, which is now regulated in such wells, according to the state of the market, by strong tubing and stop-cocks. The quantity sent to market by the Sunbury and Erie Railroad from the Pennsylvania oil region, which has thus far been the principal source, increased from 325 barrels in 1859 to 134,927 barrels in 1861. The whole quantity shipped in the last-mentioned year was nearly 500,000 barrels. Since August, 1861, the product has rapidly increased. The present capacity of the wells is estimated at 250,000 to 300,000 barrels per week. So important, however, have the operations in this article become, that a railroad, we understand, has been chartered in Pennsylvania exclusively for the transportation of the oil to market. From a recent number of the *Register*, a newspaper published in Titusville, Pennsylvania, we copy the following statement respecting the production of petroleum in that vicinity:—"We learn that the number of wells now flowing is 75; the number of the wells that formerly pumped and flowed is 62; the number of wells sunk and commenced is 358; total, 495, The amount of oil shipped is set down at 1,000,000 barrels; amount on hand to date, 92,450 barrels; present amount of daily flow, 5717 barrels. The average value of the oil, at $1 per barrel, is $1,029,000; average cost of wells, at $1000 each, is $495,000; machinery, building, &c., from $500 to $700 each, $500,000. The total number of refiners is 25. The detailed report of the condition of the wells shows that production is on the increase. Holders are firm at fifty cents per barrel at the wells, and don't seem to care about selling any great amount at that price." With increased facilities for getting it to the seaboard at a cheap rate for transportation, the operations will doubtless become much more extended than at present. The quantity exported from the cities of Philadelphia, New York, Boston, Baltimore, and San Francisco, from January 1 to April 1, 1862, amounted to 2,342,042 gallons, valued at $633,949. The receipts at Cincinnati, during the same period, of carbon and petroleum oils, were 519,960 gallons, or 13,000 barrels, nearly one-half of which was petroleum oil. The exports from the three cities first mentioned, from January 1 to May 16 of the present year, were 3,651,130 gallons, worth $889,886, and the shipments in the last week of that period from the same places were 255,600 gallons, valued at $42,160.

A large reduction has taken place in the price since the commencement of the trade, and particularly during the last few months. The price of crude petroleum in Philadelphia on January 4, 1862, was from 22½ to 23 cents a gallon, and of refined oil 37½ to 45 cents. On March 29 the prices declined at the same place to 10 and 12 cents for crude, and 25 to 32 cents for refined oil, while the most recent price current lists place it at 9 and 19 cents. Although the capacity of the existing wells already exceeds a profitable demand, there appears to be no assignable limit to the flow, or to the localities which may be found to yield it, whenever an augmented demand shall warrant further search or increased production.

Illuminating oil from coal appears to have been made as early as 1846 by Dr. Gesner, of Nova Scotia, and in 1854 the Kerosene Oil Company, on Long Island, commenced the first manufacture of carbo-hydrogen oil under patents secured by Dr. Gesner, using cannel-coal from England, New York, and other parts of the United States. The Breckinridge Coal Oil Works on the Ohio, at Cloversport, Kentucky, were commenced in 1856, and were soon followed by others, to the number of twenty-five in operation in 1860 in Ohio alone, with a working capacity of three hundred gallons of light oil each per diem. There were then about fifty-six factories in the United States, exclusive of some fifteen engaged altogether on petroleum, and several small private coal oil works. The capital expended in coal oil works and cannel-coal mines was estimated at nearly four million dollars. The manufacture of coal oil lamps, resulting from the use of the oil, formed the principal business of sixteen companies, who employed 2150 men, and 400 women and boys, and work for 125 looms in making the lamp wick.

* From the United States Census Statistics.

Improvements in the Manufacture of Iodine.—The manufacture of iodine is rather an important branch of industry, and in France occupies several thousand persons. In Ireland there are, we believe, but one or two manufactories in which the article is prepared—namely, Mr. Ward's, of the County of Donegal; and a small one at Galway. As, however, the raw material abounds to excess in this country, and as there is a good demand for the manufactured article, there is no good reason why the preparation should be confined to two districts. That this belief is not peculiar to ourselves is evident from the prospectus of a company which now lies before us. This prospectus states that Mr. M'Ardle, formerly the Operative Chemist in the Apothecaries' Hall of Ireland, has discovered a method of preparing iodine from sea-weeds, by which a yield 400 per cent. greater than by any other process is obtained. At present the kelp is prepared by completely dissipating, by the agency of fire, the organic portion of the plants, during which process there is a continuous loss of iodine, which, even in combination with sodium or potassium, is partly dissipated at a high temperature. To prevent this loss Mr. M'Ardle proposes to ferment the plants in tanks or other convenient vessel, whereby the organic portion will speedily be resolved into invisible gases, which will escape, leaving a fluid in which all the mineral matters originally contained in the plants will be found, unaltered in composition and undiminished in quantity.—*Irish Country Gentleman's Magazine.*

ANSWERS TO CORRESPONDENTS.

J. W.—No colour can be extracted from Prussian blue. It is a chemical compound, of a blue colour.

A Subscriber wishes to know by what means he can take the green shade out of indigo blue—commercial indigo, we presume, he means. He can obtain pure indigo blue by several processes, for which see "Brande's Manual," page 1478.

LL. D.—Berthelot's alcohol, obtained by synthesis, is to be seen in Case 204—the first in the second row in this class of the French Department. The bottle stands in a corner, near the top, on the left hand, and may be easily overlooked.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On certain Tungstates and Combinations of Oxide of Tungsten, by M. C. SCHEIBLER.

Extraction of Tungstic Acid.—Well pulverised wolfram is exposed for an hour and a half or two hours to the temperature of a blast furnace, with a third its weight of pure anhydrous carbonate of soda. The mass resulting from this fusion, coarsely crushed and treated with boiling water, yields a solution which is to be moderately concentrated by evaporation, and to it, while warm, hydrochloric acid is added, until it offers only a feeble alkaline reaction. By the action of the hydrochloric acid, white or yellowish brittle masses of hydrate of tungstic acid are separated, which redissolve the more easily the more alkaline the liquid. When the solution is only slightly alkaline it is filtered whilst hot. It deposits, on cooling, an abundant crystallisation of tungstate of soda. A second evaporation furnishes a second deposit. All the crystals obtained are purified by several successive crystallisations.

The purest mother-waters are precipitated whilst hot by chloride of calcium; the tungstate of lime obtained, first washed in water, then in lime-water, is decomposed by hydrochloric acid; the hydrate of tungstic acid remaining is washed by decantation, then kept under water. It serves for preparing salts of ammonia and metatungstate of soda.

The residuum of the treatment of the melted mass by boiling water is taken up by hydrochloric acid to remove the oxides of iron and manganese, then washed and melted a second time with carbonate of soda. The residuum of this further operation contains all the niobic acid of the wolfram, and will serve for the extraction of that body.

Methods of separating Tungstic Acid and Alkalies.—The author has tried the three processes of Scheele, Berzelius, and M. Margueritte, and has found them to be very exact, especially that of Berzelius.

The first of these methods consists in treating the tungstate, dissolved or finely powdered, with excess of hydrochloric or nitric acid, evaporating to dryness, heating to 110° or 112° C., dissolving in water and filtering. This is a general process.

The second, applicable to soluble tungstates only, consists in precipitating the solution by mercurial nitrate, filtering, washing, calcining, and weighing. The base can be estimated in the filtered liquid.

In the third method, especially applicable to alkaline salts, the solution is mixed with excess of weak sulphuric acid, evaporated on a water-bath, and slightly calcined to expel the excess of sulphuric acid. It is then dissolved in water, and the tungstic acid separated by filtering.

After separation of the base, care must always be taken to search in it for tungstic acid, whose presence is easily recognised by the blue colour produced by the addition of a small quantity of metallic zinc to the acidulated solution of the base.

Tungstates.—According to M. Scheibler, bitungstates, for which the formula $RO.2WO_3$ is generally attributed, have a composition explained by the formula

$$3RO.7WO_3 \text{ or } 2RO.3WO_3 + RO.4WO_3.$$

He has examined the following salts:—

Tungstate of Soda ($3NaO.7WO_3 + 16Aq.$)—This is the salt obtained as above described. It exists in beautiful enamel white crystals, of the oblique rhomboidal prism type—

(M on M = 130°.50′; M on P = 117°.38′),

unalterable in ordinary air, efflorescent in dry air, losing 12 atoms of water at 100°, and nearly all of it at 300°, and remaining always soluble. When calcined, the salt melts, and is converted into a crystalline mass containing the two salts, $2NaO.3WO_3$ and $NaO.4WO_3$, which may be separated by water, the first being soluble; the second, in the form of nacreous plates, being insoluble.

By crystallising the solution by evaporation, at a temperature between 80° and 100°, crystals of another form are obtained, containing only 14 Aq.

Tungstate of Potash ($3KO.7WO3 + 6Aq$).—Prepared by decomposing carbonate of potash by tungstic acid. It is very little soluble in water.

Tungstate of Ammonia ($3Aq.H_4O.7WO_3$) contains 6Aq when crystallised cold, and only 3Aq. when crystallised hot. Tungstate of lithia is very soluble, and crystallises easily with 16Aq.

Tungstate of Baryta.—By adding baryta water to a hot solution of tungstate of soda as long as the precipitate re-dissolves, and by then leaving it to cool, a crystalline powdery precipitate is obtained, containing

$$2NaO.BaO.7WO_3 + 14Aq.$$

The mother-waters of this salt added to a new quantity of baryta water, deposit a second precipitate, no longer containing soda, with the formula

$$BaO.WO_3 + \tfrac{1}{2}Aq.$$

Metatungstates.—The best method of preparing alkaline metatungstates is to boil a solution of tungstate with excess of hydrate of tungstic acid, until a portion of the filtered liquid is not rendered turbid by hydrochloric acid. It is then only necessary to evaporate the solution slowly over sulphuric acid.

The other metatungstates can be obtained by double decomposition with salt of baryta, or, better still, by saturating metatungstic acid by carbonates.

Metatungstates, dried in a vacuum at 100°, still retain 1 molecule of water, which can be expelled only by calcination.

As has been stated above, metatungstate of soda can be obtained by calcining the tungstate. The anhydrous quadritungstate, which remains insoluble after the cal-

cination of the tungstate, may be considered as anhydrous metatungstate. By heating it, in a closed vessel with water, at 110° or 120°, it is transformed into crystallisable and soluble metatungstate. Prepared by this or any other process, metatungstate of soda contains $NaO.4WO_3+10Aq.$ It crystallises in beautiful white octahedrals, appertaining probably to the regular type. It is soluble in hot water in any proportion.

Metatungstate of Potash ($KO4WO_3+8Aq.$) crystallises also in beautiful efflorescent octahedrals. Metatungstate of ammonia ($NH_4O.4WO_3+8Aq.$) may be obtained by heating tungstate of ammonia at 250° or 300° during a certain time, dissolving in water, and filtering. The crystals resemble those of the two preceding salts.

Metatungstate of Lithia is uncrystallisable. That of baryta is formed by mixing a solution of chloride of barium with one of the alkaline metatungstates. It crystallises in beautiful octahedral bases, of the square-based prism type, modified at their angles by the faces of the prism. It is very soluble in hot water; but cold water separates it into metatungstic acid and a white powder, $BaO.3WO_3+6Aq.$ capable of recombination by boiling.

Metatungstate of baryta effloresces above sulphuric acid. It loses 6 equivalents of water at 160°.

Metatungstic Hydrate, produced by decomposing metatungstate of baryta with sulphuric acid. Its aqueous solution is colourless, strongly acid, and able to decompose nitrates and chlorides. Evaporated in a dry vacuum, it crystallises in small octahedrals, belonging apparently to the square-based prism type, and containing

$$2HO.4WO_3+7Aq.$$

They lose 7HO at 100°, and the other 2HO by calcination only.*

These solutions can undergo boiling without decomposition; however, when past a certain degree of concentration, they form a mass, and become transformed into white hydrate or ordinary yellow tungstic acid.

The author has also studied the following metatungstates:—*Metatungstate of strontia*, $SrO.4WO_3+8Aq.$ in square-based octahedrals of *lime*, containing 10HO; of *magnesia*, $MgO.4WO_3+8HO$, in crystals belonging probably to the oblique rhomboidal prism type; of *cerium*, *lanthanium*, and *didymium*, all three crystallisable; of *glucinum*, in deliquescent lamels; of *alumina* and *peroxide of iron*, uncrystallisable; of *protoxide of iron*; of *protoxide of manganese*, $MnO.4WO_3+10HO$, in square-based octahedrals; of *zinc*, in very soluble crystals, containing 10HO; likewise of *cadmium*, which forms brilliant square-based octahedrals; of *nickel* and *cobalt*, the first in oblique prisms with 8HO, the second in square-based octahedrals with 9HO; of *copper*, in plates containing 11HO; of *silver*, $AgO.4WO_3+3HO$ in crystalline crusts of waxy brightness; of *lead*, $PbO.4WO_3+5HO$; and of *protoxide of mercury*, $Hg_2O.4WO_3+25HO$ (?) — the two last obtained by precipitating metatungstate of soda by acetate of lead or mercurial nitrate. They are insoluble in metatungstic acid.

Iodide of ethyle and metatungstate of silver react on each other at the ordinary temperature, forming a syrupy, uncrystallisable mass, easily decomposed, and seemingly composed of metatungstic ether.

The author supposes the formula of this compound to be

$$W_4 \left\{ \begin{matrix} C_4H_5 \\ H_3 \end{matrix} \right\} O_{16}$$

On the Combination af Oxide of Tungsten.—Two combinations are known of tungstic acid with soda and potash, containing, besides acid, an inferior oxide of tungsten.§ Two analogous bodies, tungstate of tungsten and of lithia, in the shape of small quadrangular blue tablets, the author has prepared, by the addition of tin to tungstate of lithia in a state of fusion, and a salt of soda, containing $NaO.WO_3+2(WO_2WO_3)$, are deposited in blue cubes with coppery reflections, at the negative pole, on passing an electric current into melted tungstate of soda. These crystals are unattackable by acids or alkalies, and are good conductors of electricity.

On the Atomic Weight of Tungsten.—The determinations of the author were arrived at by means of metatungstate of baryta, which is easily obtained in a state of great purity. The author gives the preference to the numbers obtained by estimating the water in the salt, $BaO.4WO_3.9HO$, from which he deduced the number 92 as the equivalent of tungsten.

M. Scheibler, as M. Riche had already admitted (*Annales de Chemie et de Physique*, 3rd Series, vol. l. p. 5), recognises only two modifications of tungstic acid, ordinary acid, and metatungstic acid.—*Journal für Praktische Chemie*, vol. lxxxiii. p. 273.

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by Frank H. Storer *and* Charles W. Eliot.*

(*Continued from page* 171.)

II. Analogous Chromates.

The metals with which chromium is allied are aluminum, iron, and manganese, and the existence of chromates of the sesquioxides of these metals, with properties analogous to those which we have described as belonging to the chromate of chromic oxide, will be additional evidence that this substance is rightly so called.

1. Chromate of Alumina.——Maus† observed, but did not analyse, the chromate of alumina which is precipitated when chromate of potash is added to a solution of alumina in chromic acid; he speaks of it as "consisting of chromic acid with much alumina." When the precipitate was thoroughly washed, pure hydrate of alumina remained on the filter, and acid chromate of alumina passed into the filtrate. Fairrie‡ also describes a chromate of alumina prepared by mixing alum solution with the solution of chromate of potash, and his analysis led to the exact formula $Al_2O_3CrO_3$; he states,

* From the method of preparing metatungstates, and the composition of hydrate of metungstic acid, there can be little doubt that this body is analogous to dilactic acid, the existence of which M. Wurtz and myself made known (*Annales de Chimie et de Physique*, vol. lxiii. p. 112), and to the ditartaric and disuccinic acids, the production of which, under similar circumstances, has been described by M. Schiff (*Comptes Rendus*, vol. liv. p. 1075). Thus we should have the formula,—

$$\left.\begin{matrix} 2WO_2 \\ 2WO_2 \\ H_2 \end{matrix}\right\} O_8 \text{ for metatungstic acid and } \left.\begin{matrix} 2WO_2 \\ 2WO_2 \\ MH \end{matrix}\right\} O_6$$

for metatungstates. In fact, all metatungstates contain one molecule of water, expellable only at a very high temperature. This view of the subject would be quite natural if the formula $\left.\begin{matrix} 2WO_2 \\ 2H \end{matrix}\right\} O_H$ were admitted for ordinary tungstic acid, which would agree with former analyses, but not with M. Scheibler's.—C.F.

§ Wöhler, *Poggendorff's Annalen*, vol. ii. p. 345; Malaguti, *Annales de Chemie et de Physique* (2nd Series), vol. lx. p. 271; Wright, *Annalen der Chemie und Pharmacie*, vol. lxxix. p. 221; Laurent, *Annales de Chemie et de Physique* (2nd Series), vol. lxvii. p. 219.

* Read before the American Academy of Arts and Sciences.

† *Pogg. Ann.*, xi. 82 (1827).

‡ *Jour. Chem. Soc.*, iv. 301 (1852).

however, that the precipitate was thoroughly washed, which, in connection with the result of his analysis, is quite incomprehensible; for Maus observed, and our own experiments fully confirm his observation, that all the chromic acid may be readily washed out of this compound.

The yellow precipitate which appears when chromate of potash is dropped into a solution of alum, is constantly redissolved until the proportion of chromate of potash added amounts to five equivalents to each one of alum; the precipitate then becomes permanent; it is light yellow in colour, and has a gelatinous appearance, which suggests an excess of alumina. The reaction is evidently the same as that above given for the precipitation of chromate of chromic oxide.

$$5\,(KO\,CrO_3) + Al_2O_3\,3\,SO_3, KO\,SO_3 = 4\,(KO\,SO_3) + 2\,(KO\,2\,CrO_3) + Al_2O_3CrO_3.$$

The precipitate was drained, pressed between folds of filter-paper under heavy weights, and air-dried. The filtrate, when evaporated and crystallised, gave crystals of bichromate of potash, and of sulphate of potash mixed with the slight excess of chromate of potash. The presence of soluble salts in the pressed precipitate, and its decomposition by washing, determined us to the third method of analysis described (page 137). Omitting the subsidiary weighings, we give the essential figures of our first analysis of this substance:—

	Grammes
Weight of the precipitate analysed	0·5997
Weight of water found	0·1948
Weight of oxygen found	0.0197
Weight of soluble salts found	0·1969
Weight of mixed precipitate of $Cr_2O_3 + Al_2O_3$	0·1883

It will be remembered that the water and the precipitate of chromic oxide and alumina are actually weighed, the oxygen being determined by subtracting the water found from the total loss by ignition, and the soluble salts by subtracting the weight of the precipitate of chromic oxide and alumina from the weight of the whole residue after ignition. The amount of chromate of alumina corresponding to the oxygen lost by ignition may be calculated as follows:—Ignition drives off half of the oxygen originally combined with the chromium; hence—

Oxygen in the chromic acid of precipitate	= 0·0394
Chromic acid correspondiog to this oxygen	= 0·0825
Chromate of alumina corresponding to this chromic acid	= 0·1666

This calculation rests entirely upon the single determination of the oxygen; and an inspection of the steps of the process will show that any error in the amount of oxygen, or rather in the water determination on which the weight of oxygen depends, is multiplied by eight and a fraction in the calculated amount of chromate of alumina. A considerable discrepancy is therefore to be expected between the amount of chromate of alumina so calculated, and the amount actually found in the analysis, the sum of the oxygen and of the mixed precipitate of chromic oxide and alumina. That sum is in this analysis 0·208 gram.; subtracting the calculated amount 0·1666 gram., we find a discrepancy of 0·0414 gram. By subtracting 0·005 gram. only from the weight of the water determined, this error would be corrected, and the precipitate would coincide exactly with the formula Al_2O_3, CrO_3, or, as the figures stand, its composition is very nearly that represented by the formula $(Al_2O)_3\,(CrO_3)_2$. Of course, a method of analysis involving such a multiplication of an error, however small, is objectionable, but we were at a loss to devise a better.

A second analysis gave a similar result; the discrepancy between the calculated and the actual numbers was four milligrammes larger than in the first analysis, and the figures of the analysis gave a chromate of alumina a little more basic than that represented by the formula $(Al_2O_3)_3\,(CrO_3)_2$. We attach very little importance to any such formula. The fact seems to be that the normal composition of the chromate of alumina precipitated by the double decomposition of alum and chromate of potash is represented by the formula $Al_2O_3\,CrO_3$, but that the compound is a feeble one, and parts readily with some of its chromic acid to the water of the solutions from which it is precipitated; hence the basic character of the precipitate analysed. How Fairrie obtained a thoroughly washed chromate of alumina having the formula $Al_2O_3\,CrO_3$, is a mystery upon which our experiments have thrown no light.

2. Chromate of Iron.—We have already cited the observations of Thomson concerning this chromate, which he found after washing to be very basic, and also the statement of Maus concerning the acid chromate of iron with four equivalents of chromic acid, obtained by digesting hydrated sesquioxide of iron in aqueous chromic acid. It remained for us to analyse, as exactly as the circumstances permit, the unwashed chromate of iron which is precipitated when chromate of potash is mixed with perchloride of iron. The method of analysis was the same as that used for chromate of alumina, with the disadvantage that the error in the amount of oxygen found is multiplied by ten instead of by eight in calculating the chromate of iron, because the atomic weight of the sesquioxide of iron is larger than that of alumina. The stability of the chromate of iron is greater, however, than that of the chromate of alumina, and the results of the analyses are very much nearer to the formula $Fe_2O_3CrO_3$, than those of chromate of alumina to the formula $Al_2O_3\,CrO_3$. The formula for the reaction whereby the brown chromate of iron is precipitated, is the same as those already given for chromate of chromic oxide and chromate of alumina, viz.:—

$$Fe_2Cl_3 + 5\,(KO\,CrO_3) = 3\,(KCl) + 2\,(KO\,2\,CrO_3) + Fe_2O_3\,CrO_3.$$

Until the requisite amount of chromate of potash had been added to the perchloride of iron, the precipitate redissolved; when it became permanent, it was drained, pressed, and air-dried for analysis.

Analysis 1.

	Grammes.
Weight of the precipitate analysed	0·6626
Weight of water found	0·0966
Weight of oxygen found	0·0395
Weight of soluble salts found	0·2288
Weight of mixed precipitate of $Fe_2O_3 + Cr_2O_3$	0·2977

From these data may be obtained by the necessary proportions,—

Oxygen in the chromic acid of precipitate	0·0790
Chromic acid corresponding to this oxygen	0·1654
Chromate of iron corresponding to this chromic acid	0.4287
Chromate of iron found = $Fe_2O_3 + Cr_2O_3 + O$ weighed	= 0·3943
Excess of the calculated chromate of iron over the found	= 0·0344

This error would be perfectly corrected by a loss of three milligrammes in the water determination, or as the figures stand without any correction they would lead to the conclusion that the precipitate was a chromate of iron of the formula $Fe_2O_3\,CrO_3$, but containing a very small excess of chromic acid.

Analysis 2.

	Grammes.
Weight of the precipitate analysed	0·6590
Weight of water found	0·0990
Weight of oxygen found	0·0360
Weight of soluble salts found	0·2254
Weight of mixed precipitate of $Fe_2O_3 + Cr_2O_3$	0·2986

From these data may be obtained by the necessary proportions,—

Oxygen in the chromic acid of precipitate	0·0720
Chromic acid corresponding to this oxygen	0·1197
Chromate of iron corresponding to this chromic acid	0·3597
Chromate of iron found = $Fe_2O_3 + Cr_2O_3 + O$ weighed	= 0·3346
Excess of the calculated chromate of iron over the found	= 0 0251

This error would be corrected by a supposed loss of little more than two milligrammes in the water determination. This second analysis, therefore, confirms the view, that the normal composition of this chromate of iron is represented by the formula $Fe_2O_3\,CrO_3$.

It is unnecessary to call attention to the great similarity of the properties of the chromates of chromic oxide, ferric oxide, and alumina; their normal composition is represented by the formula $R_2O_3CrO_3$, but they are such feeble compounds as seldom to be found of the exact constitution which the formula indicates.§ Of the three, the chromate of chromic oxide is the most stable, and we have been able to prepare it with the exact theoretical composition, from which it so easily varies. It should be observed, that a variation in the composition of these chromates, amounting to even 10 per cent. of their chromic acid, does not affect in the least their external properties, and it is by no means impossible that they are examples of that variation in the law of definite proportions which has been ably discussed by Professor J. P. Cooke in the "Memoirs" of this Academy;‖ but unfortunately, as must often be the case, the limits of error of our methods of analysis are wider than those of the supposed variation; and moreover, on this border-land between the kingdoms of Chemical and Mechanical Force, there must always be doubt and difference of opinion concerning the cause to which a proved effect is to be ascribed.

(To be continued.)

§ The monochromate of glucina mentioned by Gmelin (*Handbook*, v. 155, Cavendish Soc. Ed.) evidently belongs to this class.

‖ New Series, v. pp. 348, 352 (1854).

On the Volumetric Estimation of Iron by Hyposulphite of Soda, by M. H. LANDOLT.

As M. Mohr has shown (*Annalen der Chemie und Pharmacie*, cxiii. 257) the direct estimation of perchloride of iron, by means of a solution of hyposulphite of soda, does not give satisfactory results. The cause of error lies chiefly in the decomposing action exercised by free hydrochloric on hyposulphurous acid.

By using sufficiently diluted acetic instead of hydrochloric acid, or by treating the weak hydrochloric liquid by acetate of soda, it will be found that the hyposulphurous acid is not decomposed, even after some length of time. Consequently, a solution of perchloride of iron may be estimated by means of a hyposulphite solution, taking care to add previously sufficient acetate of soda to make apparent the red colour of the ferric acetate, and then sufficient weak hydrochloric acid to make this colour again disappear. Then pour into the solution a known quantity of hyposulphite, and estimate the excess of this reagent, which colours the liquid a deep violet, by means of starch paste and iodine solution.

Very exact results are obtained in this way; but care must be taken to use liquids not too much diluted; 0·00012 gramme is the minimum amount of iron which should be contained in 1 cubic centimètre.

1 equivalent of perchloride of iron exactly decomposes 2 equivalents of hyposulphite of soda:—

$$Fe_2Cl_3 + 2(NaO.S_2O_2) = 2FeCl + NaO.S_4O_5 + NaCl.$$

—*Journal für Praktische Chemie*, vol. lxxxiv. 339.

On the Manufacture of Caustic Soda, by A. NORMAN TATE, *F.C.S.*

(*Concluded from page* 175.)

The consumers of solid caustic soda have a great objection to the presence of iron in it, and it is very desirable that it should be separated. Now, without doubt, this should be done as early as possible, and before the liquors become strong; and if the iron can be separated, not in the state of oxide, so much the better. I am not aware that this is done. It may, however, be effected by the employment of Mr. Gossage's oxidising tower. If the black-ash liquors, or even the red-liquors are subjected to the action of air in Mr. Gossage's tower, the sulphide of sodium is converted into sulphate or sulphite, and the sulphide of iron is precipitated. It therefore follows, that if the liquors are properly settled, all the iron which existed as sulphide may thus be separated at the very commencement of the process (a great saving of nitrate of soda would also be effected).* There still, however, remains some iron in the form of ferrocyanide of sodium, and all this does not separate as salts, but the iron of the ferrocyanide is converted into peroxide of iron, which either remains dissolved by the soda, or separates as a precipitate. There is also the oxide of iron (in the shape of rust) which the soda takes up from the vessels used in the manufacture, and, unless I am mistaken, the concentrated soda liquors act upon metallic iron. By exposing a piece of good wrought iron to the action of the liquor in the finishing-pot for two or three days, I found it to materially lessen in weight. I had not time to carry out the experiment in a complete manner, so as to satisfy myself upon the point. There are so many compounds present in the liquors that the action upon iron may not be due to hydrate of soda, but probably to other compounds. The iron is, however, only acted upon but very slowly. I have no doubt means will soon be adopted to free the caustic soda from the small quantity of iron it now contains, for several persons are working at the subject, and I am informed that already some samples have been produced which are very nearly chemically pure.

The CHEMICAL NEWS of June 28, 1862, contains an article by Dr. P. Pauli, of the Union Alkali Works, St. Helen's, upon "The Preparation of Pure Caustic Soda on a Large Scale," and the process there described will, I believe, meet the difficulty which is at present experienced in preparing caustic soda free from iron, &c. The following is Dr. Pauli's description of the process:—"Three tons of commercial caustic soda, containing excess of water, alumina, and all the impurities which commonly occur in this substance, are fused in a cast-iron pot. During the evaporation, nearly all the carbonate and by far the larger quantity of the other salts

* I am informed that this process has lately been adopted in an extensive Lancashire works.

separate out on the surface as a scum, and can be easily removed. The liquid mass is then heated to dull redness, and kept at that temperature during the night. In the morning the mass appears perfectly transparent, the sides and bottom of the vessel being coated with cauliflower-shaped masses of crystals, consisting of silicate of alumina, with chloride and sulphate of sodium, and a little lime. The clear fused liquor is ladled off from these crystals, and when cooled is ready for use."

Dr. Pauli remarks, that the soda thus obtained contains only a trace of carbonate of sodium, is perfectly free from alumina, and that oxide of iron is completely separated from it; also that it is hard and brittle, and may be easily obtained as a fine powder by attrition in an iron mortar.

A few experiments I have made since reading Dr. Pauli's paper fully corroborate the statements therein contained.

Use of Chloride of Lime.—Before going any further, I would make a few observations respecting the use of chloride of lime. Its use should be avoided, for, although it effects the object desired,—the oxidation of some of the sulphur compounds,—yet the advantage is more than counterbalanced by the loss of alkali it occasions by converting it into chloride of sodium. It is decidedly preferable to use nitrate of soda instead of chloride of lime, although the price of the former is much higher than that of the latter; but I have found by experiment that nitrate of soda is in the end the cheapest, as by its decomposition hydrate of soda is formed, whilst by the employment of chloride of lime some alkali is rendered useless. The results of some practical experiments which I have just completed, show that 100 parts of chloride of lime render useless about 50 parts of alkali.

Other Processes for Manufacturing Caustic Soda.—There are two or three other processes which I will just mention before concluding.

One, formerly employed, consisted in intimately mixing together one part of common salt, and from four to six parts of litharge and a little water. Chloride of lead and hydrate of soda were formed. The chloride of lead afterwards combined with some of the undecomposed litharge to produce oxychloride of lead, which, being insoluble, was allowed to deposit, and the clear liquor containing the hydrate of soda was run off and evaporated. The lead compound, when dried and fused, formed the colour known as patent yellow. This process has, I believe, been abandoned on the score of expense. With the large production of caustic soda of the present time there would also probably be a difficulty in making use of the yellow pigment. Another process which has been proposed, was to mix together solutions of hydrate of baryta and sulphate of soda. The insoluble sulphate of baryta is formed and precipitates, and hydrate of soda remains in solution. Caustic baryta cannot, however, be procured in anything like the quantity required for the carrying out of this process on a large scale.

Mr. Hunt proposed to decompose sulphate of soda by roasting it with coal or coke, and then lixiviate the mass with water. The solution contains sulphide and bisulphide of sodium, and carbonate and sulphate of soda, and is boiled with oxide of zinc or black oxide of copper. By the action of the oxide upon the sulphides of sodium, sulphide of zinc or copper is produced, which precipitates, whilst hydrate of soda remains in solution.

A process mentioned in *Silliman's Journal* for November, 1858, consists in first causticising black-ash liquors with lime. The caustic solution is then evaporated, to separate salts, and fine sesquioxide of iron (in the form of Venetian red or pure earthy hæmatite) added to it in such a quantity, that the sesquioxide shall somewhat exceed in weight the amount of dry hydrate of soda contained in the liquor. This mixture is dried down with constant stirring, and roasted at a dull red heat. The roasted mass is then treated with water so as to get a solution of sp. gr. 1·40. The clear solution is poured off and evaporated. I am not aware that this process has been adopted anywhere in this country.

In the Chemical News of May 10, 1862, is a notice of a paper by W. Wochler, in the *Annalen der Chemie der Pharmacie*, on "The Preparation of Caustic Soda." This process consists simply in calcining nitrate of soda with peroxide of manganese. No chameleon is formed, as might be supposed, since the nitrate decomposes long before the mixture can reach the temperature necessary for the production of manganic acid. This process appears to me to be too expensive to be used for the preparation of caustic soda on a large scale.

A word or two respecting the mode of using the black-ash liquors for the production of solid caustic soda. The black-ash liquors contain both hydrate of soda and carbonate of soda, the quantity of soda as hydrate existing generally in the proportion of about 25 parts to every 75 parts of soda as carbonate. Now, if the carbonate of soda is at once converted into caustic soda by the addition of lime, it is necessary, as the black-ash liquor has on the average a sp. gr. of 1·25 or 1·26, to add water to the whole of the liquor to reduce it to a sp. gr. of 1·10, and by so doing the caustic portion is diluted as well as the carbonate. In order to produce solid caustic soda, this water must again be expelled. It appears to me to be a better plan to first concentrate the black-ash liquors, so as to separate all the carbonate as salts. This may then be redissolved in water, causticised, and then evaporated with the other caustic liquor (the red liquor).

I am of opinion that the process for the manufacture of caustic soda, as the consumption of that article increases, must be conducted something after the manner of the process described in the patent of Mr. Gossage, which I mentioned at the commencement of this paper; but, instead of using the salts obtained for the production of soda-ash, they will be redissolved, causticised, added to the red liquors, and the mixed liquors concentrated to produce solid caustic soda.

In a few words I will give an outline of what the process would then consist of.

Oxidise black-ash liquor in the oxidising tower, and allow the sulphide of iron to deposit; concentrate the liquors until all carbonate has separated; redissolve this carbonate and causticise; add the causticised liquor to the red liquor and evaporate, adding as much nitrate of soda as is required.

I have now described the manufacture of solid caustic soda. I might perhaps have given a more minute description of the various processes and of the apparatus employed, but such details are only interesting to those actually engaged in the manufacture, and therefore I consider it unnecessary to enter into them here. What I have described embraces all the principal points in the manufacture.

In conclusion, I would remark that the production of solid caustic soda is one of the many advantages which have been derived from bringing science to bear upon the practical working of our manufacturing operations.

Of all the sciences, chemistry has without doubt contributed the most to promote the growth and development of the arts and manufactures; and one of the

greatest examples of the importance of chemistry in its practical applications is the rise and development of the soda manufacture.

As Liebig justly remarks,† 'The manufacture of soda from common culinary salt may be regarded as the foundation of the extraordinary impulse given to improvement in every department of modern industry; and we may take it as affording an excellent illustration of the dependence of the various branches of human industry and commerce upon each other, and their relation to chemistry."

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PHYSICAL SCIENCE.

On a New Ozone Box, by* E. J. Lowe, *F.R.A.S., F.G.S., &c.*

The present ozone box has been constructed so as to insure perfect darkness to the test paper without interfering with the passage of a current of air. There are two openings into this cylindrical box, one above and the other below. These openings are not direct into the box itself, but into narrow winding passages in the first instance; they are also opposite each other. If the wind is moving in an easterly current, and the upper opening is on the east side, then the air will enter the central cavity where the test paper is hung, afterwards passing round the lower passage in a contrary direction, and out again at the westerly aperture; or if the wind happens to be in the opposite direction, it will enter from below, and leave the box from above. In practice the ozone box is hung in an exposed situation, a swivel and small vane being used to keep the aperture to the wind's direction. The advantage to be gained is obvious; a perfect current of air passes through a quite dark chamber, the box itself being small, and its cost almost nominal. Having briefly described this box, I will now give the result of a series of observations made at Beeston during the past four years.

If the apertures are closed the test papers will remain uncoloured.

If one aperture be closed the air will not circulate in the box, and the test paper will still remain uncoloured.

If the temperature is raised the amount of ozone will increase.

If the pressure of the air increase the amount of ozone will decrease.

The more direct is the current of air with regard to the opening into the box, the more ozone is recorded.

1st. With regard to the closing of one or both apertures, a month's experiments (made at a time when there was much ozone in the air) did not show a single instance of the test papers being discoloured.

2nd. With regard to an increase in temperature giving an increase of ozone. If the temperature be ranged in 10° series, a temperature between 30° and 40° will give less ozone than one between 40° and 50°, and this latter less than one between 50° and 60°. Artificially, if a night light be made to burn in a cell below the box, so as to warm it, there will be an increase in the amount of ozone over another box that is without a night light.

3rd. With respect to an increase in ozone resulting from an increase in the speed of the air. It has been shown from a long series of observations that most ozone has been present when there has been a gale blowing.

It does not necessarily prove, that under these circumstances there is actually more ozone in the air because more is shown, for it must be borne in mind that, supposing the amount of ozone in a cubic foot of air were always the same, still if to-day 300 cubic feet of air only occupy the same space of time in passing through the box as 100 cubic feet occupied yesterday, we shall have more ozone apparently to-day than yesterday. The same holds good, I believe, with regard to an increase in temperature, chemical action increasing with an increase of heat; it is therefore manifest that the same amount of ozone passing through the box at a temperature of 60° would necessarily darken the paper more than the same amount at a temperature of 40°.

I feel certain that corrections are requisite in order to give a correct record of the amount of ozone. To make this clear we will call the ozone scale 100 instead of 10, by which means we shall do away with the decimals that are requisite with the usual scale of 10. With regard to the pressure of the air, there is a striking difference between the readings of the ozonometer with a high or low barometer. Taking the four days in each month during the past year on which the mean pressure was greatest, the average amount of ozone was 12; whilst taking the same number of days when the barometer was lowest, the mean was 41, or nearly four times as much. On taking the same readings during the past four years, very similar results are shown:—The mean maximum pressure for the whole twelve months of the four years is 30·22 inches, the mean ozone being 10. The mean minimum pressure for the same period is 29·18 inches, the mean ozone being 32, or more than three times as much. With the barometer at 28½ inches the mean ozone is 57, at 28¾ inches it is 41, at 29 inches 35, at 29¼ inches 28, at 29½ inches 20, at 29¾ inches 16, at 30 inches 13, at 30¼ inches 5, and at 30½ inches only 4. The table appended, which I need not detain the Association in reading, will show this more in detail. Another correction is necessary with regard to the amount of ozone at different portions of the twenty-four hours. On the average during the past four years, the difference between the ozonometer readings during the night and day are as follow:—In December and January, an excess at night over the day of 8; in February and March of 7; in April and May of 7; in June and July of 1; in August and September of 4; in October and November of 5; the average of the summer months being in excess only one-half of that which occurs in the winter.

† Letters on Chemistry, p. 267.

* Read before the British Association.

PROCEEDINGS OF SOCIETIES.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Thirty-second Annual Meeting of the British Association commenced at Cambridge on Wednesday, October 1.

The attendance this year, though not large, is as respectable in point of numbers; and the various sections were well represented by gentlemen of eminence in the different departments of science. Professor Willis is the President of the year, and delivered the Inaugural Address on Wednesday evening. His address was devoted to a statement of the objects of the Association, a history of its proceedings, and a detailed account of the various grants of money made by it, for the advancement of science, during the thirty years of its existence. The last, it seems, have amounted to 20,000*l*. Two-thirds, or twelve parts of this sum, it appeared, had been expended on the sections of

mathematics and physics; geology and mechanical science had received two parts each; and one part had been given to botany and zoology. It further appeared that very little had been devoted to the advancement of chemistry, only one-eighteenth having been divided among the sections of chemistry, geography, and statistics; and we believe it may be added with truth, that but a very small proportion of this eighteenth has been allotted to the first of these sciences. The large share assigned to the first section, the President said, was sufficiently accounted for by the nature of the subjects included in it, which require innumerable and expensive instruments of research, observations, and expeditions to all parts of the globe. The principal items of expenditure mentioned were for catalogues of the stars, the maintenance of Kew Observatory, observations to determine the course of the tide wave in various parts of the world, and for the construction of instruments, and a series of observations and surveys in connexion with meteorology and terrestrial magnetism. 2600*l.* have been expended on geology; 1600*l.* of which were employed in the completion of the fossil ichthyology of Agassiz, and Owen's reports on fossil mammalia and reptiles; and 900*l.* had been paid for experiments conducted by Mr. Scott Russell on the forms of vessels. The results of these valuable experiments were ready for the press in 1844, but the great expense of printing them has hitherto prevented their publication, which is no doubt to be regretted. 900*l.* have been expended on zoological researches in different districts and countries; much of it on dredging committees for obtaining specimens of the marine zoology of our own coasts. 200*l.* have been disbursed by a committee formed in 1840 to make experiments on the preservation of the vegetative power in seeds, which have resulted in the discovery, that the greatest age at which seeds were found to vegetate was about forty years.

As is usual on these occasions, the President, in his address, passed in review the principal scientific events of the year, chemistry being referred to as follows:—"In chemistry the greatest advance which has been made during the past year is probably the formation of compounds of carbon and hydrogen by the direct union of those elements. M. Berthelot has succeeded in producing some of the simpler compounds of carbon and hydrogen by the action of carbon intensely heated by electricity or hydrogen gas; and from the simpler compounds thus formed he is able to produce, by a succession of steps, compounds more and more complex, until he bids fair to produce from inorganic sources all the compounds of carbon and hydrogen which have hitherto been only known as products of organic origin. Mr. Maxwell Simpson has also added to his former researches a step in the same direction, producing some organic products by a synthetical process. But these important researches will be fully laid before you in the lecture on Organic Chemistry which Dr. Odling has kindly promised for Monday evening next. Dr. Hofmann has continued his indefatigable researches on Poly-ammonias, as well as on the colouring matters produced from coal tar. Mr. Schlœsing proposes a mode of preparing chlorine by a continuous process, which may, perhaps, become important in a manufacturing point of view. In this process nitric acid is made to play the same kind of part that it does in the manufacture of sulphuric acid, the oxides of nitrogen acting together with oxides of manganese as carriers of oxygen from the atmosphere to the hydrochloric acid. The methods of dialysis announced last year by the Master of the Mint, and of spectrum analysis, are now in everybody's hands, and have already produced many interesting results."

After a short notice of some public works, the learned President alluded to the lamented death of Prince Albert, and the loss of Professors Cumming and Henslow, who filled the chairs of Chemistry and Botany at Cambridge, and so concluded an address which was generally thought to be decidedly dry and somewhat dull.

In proposing a vote of thanks, the Dean of Ely amused the audience by wishing Professor Willis life, happiness, and prosperity till he had completed his report on "Acoustics" (a work begun in 1832); and the learned Dean thought that all would agree with him, that he who desired the longest life could not desire a longer than he wished the Professor.

The various Sections commenced their sittings on Thursday morning. As has been the case at the two last meetings, the greatest interest seemed to be excited by the discussions in Section D, which bore on the Darwinian theory, most of the visitors, scientific and non-scientific, lay and clerical, male and female, appearing particularly anxious to learn the exact relationship (if any) which existed between a man and a monkey.—Section B, Chemical Science, had the usual select audience. It was presided over by Professor W. H. Miller, and the Secretaries were Dr. Odling, Professor Roscoe, and W. H. Elphinstone, M.A. We append reports of some of the proceedings before the Sections.

Wednesday, October 1, 1862.

Section A.—Mathematical and Physical Science.

The sitting of this Section was held in one of the lecture rooms of Trinity College.

The President, Professor G. G. Stokes, M.A., in opening the business of the meeting, adverted in a short but appropriate speech to the object and utility of such reunions of scientific men; and spoke of the effect of co-operation, and the suggestions made at these sectional meetings, in giving a fresh impulse to scientific investigations.

The first communication made was by Mr. C. Tomlinson, "*On the Motion of Camphor towards the Light.*" He said all books on chemistry claim for camphor a tendency to make a deposit towards the light. This idea originated in the remarks made by Chaptal, a celebrated French chemist. The subsequent experiments of Dr. Draper confirmed this view, and assigned the same property to various other bodies, as water, alcohol, etc. The phenomenon was considered akin to that of the vitality of plants. He (Dr. Draper) also found, that in the months of January and February deposits were formed towards the light, but in March and April they receded from it. He named these variations by the astronomical terms of *Perihelion* and *Aphelion*, and further asserted that coloured liquids and other bodies producing reflected light produced aphelion. The conclusion arrived at by Dr. Draper, after a long series of experiments, was that light and electricity were the main agents in producing these phenomena. The speaker, however, after repeating Dr. Draper's experiments, and making many others, was led to doubt the agency of either light or electricity in the matter. Having instituted a new course of experiments, he concluded that all the phenomena in question were the result of heat alone. To separate the action of light from heat, he used opaque vessels and obtained a faint deposit; and on using a bottle covered with a substance which transmitted heat, but excluded light, he obtained a dense deposit. Artificial heat produced the same effect; the density of the deposits not depending upon the amount of light given out by the heated substance, but upon the capability of the vessel to absorb the heat. Camphor, he stated, was a substance giving forth vapour, and the deposits made by it are analogous to those of hoar frost. He here illustrated his theory by several interesting diagrams and experiments. A vessel containing camphor, when immersed in water, though exposed to the strong light of a July sun, gave no deposit; but when exposed to the same sun, with no water to obstruct the heat, a copious deposit was formed. If the vessel be exposed to light and protected from radiation, no deposit is formed. But wherever it radiates unequally, there is a cooling of the surface, and consequently a deposit. Barometers which have a wide tube, and are

set in an open frame, give a mercurial deposit; but if the tube be narrow, and protected from radiation by a wooden frame, none whatever is produced. Melloni's observation, that a piece of fallen timber, lying on the ground covered with snow, keeps a space round it free from snow, is confirmity of the theory; for in the same way a camphor bottle which is protected from radiation, as, for instance, by a bar of wood crossing part of it when exposed in the window, fails to deposit anything upon the part so covered. Mr. Tomlinson had made numerous experiments, placing bottles containg camphor in every window of his house, until his residence was known as the "bottle-house," and the conclusion at which he had arrived was, that the phenomena observed in camphor deposits was a pure effect of heat, independent of the agency of either light or electricity.

Mr. Stewart, of the Kew Observatory, detailed some experiments made by him confirming Mr. Tomlinson's conclusions.

Mr. Isaac Ashe proceeded to give the substance of his paper—"*Suggestions on Balloon Navigation.*" Mr. Ashe had read the account of the dangers undergone by Messrs. Glaisher and Coxwell at the late scientific balloon ascent at Wolverhampton. In the course of this ascent Mr. Glaisher was overtaken with a temporary paralysis, produced, Mr. Ashe contended, as much from cold as from rarefaction of the air. He here explained some contrivances for preventing similar accidents in future. He next proceeded to speak of the practicability of steering a balloon, by means of the action of a screw. This could not of course be moved by steam power, owing to the weight of the machinery required; but by constructing a light screw of oil-silk stretched upon whalebone, the force that could be applied by one man would be sufficient to regulate the course of the balloon—in a substance giving so slight a resistance as air. He contended that a height of 1500 feet would be sufficient for ordinary purposes, and there would then be no material rarefaction. The descent might be accomplished by the action of the screw, without the loss of gas; this would be a great object obtained, and, as we already knew sufficient of the aërial currents, balloons might be easily steered. This once accomplished, the difficulties of preliminary explorations, in unknown countries, would be obviated; for water, or vegetation in a sterile tract of land, may be easily perceived at a great distance from a balloon.

Mr. Watkins objected to the limitation of balloon ascents. They should be made as high as possible, in order to ascertain the component parts of the atmosphere.

Mr. Brook, considering the risk of life incurred by aëronauts, thought any proposition tending to diminish their danger one of serious importance. He did not believe that cold had anything to do with the loss of sensation experienced at great heights, but conceived it due to the want of oxygen sufficient to maintain animal existence. Our atmosphere consists of about a quarter of oxygen: at a great altitude there is not so much by one-fourth. He advised aëronauts to inhale enough pure oxygen to make up for the deficiency in the atmosphere. A bag of oxygen would be much preferable to a brandy bottle, and would not interfere with the aëronaut's experiments, as he might inhale it from a pipe, and have his hands free. He could not concur with Mr. Ashe, that the suspended animation was the result of low temperature, as the time was not long enough to allow of the body parting with sufficient heat to produce such an effect.

Mr. Varley thought it would be unsafe to take oxygen without a carrier, and suggested ammonia for that purpose.

Mr. Brook said the danger of re-inhaling the same oxygen might be obviated by simply puffing it away.

Mr. Ashe did not at all wish to limit the height for ascents, but considered 1500 feet enough for practical purposes. Pure oxygen might be respired without danger or inconvenience; but if a carrier were requisite he would recommend chlorate of potash, as ammonia would be deleterious to the lungs.

Mr. James Nasmyth next gave an account of *Some Peculiar Features in the Structure of the Sun's Surface.* He said the subject was in itself most interesting, but had been rendered much more so by the researches of Bunsen and others upon the solar spectrum. He himself had paid much atttention to the structure of the sun and moon, but lately more particularly to that of the sun. He had been fortunate enough to secure some exceedingly perfect instruments, and a very favourable condition of the atmosphere. His first observation of the phenomena he was about to describe was made on July 20, 1860. It is still a moot point as to what the spots on the sun really are, but it is generally supposed that they are openings on the luminous surface. When observing these appearances he noticed that the outer luminiferous envelope of the sun was composed of lenticular or willow-shaped filaments, and it is from these that the whole of the solar light emanates. Next to this comes the penumbra, then a misty envelope, and lastly the body of the sun itself, which is dark, dense, and not a light-giving substance. The willow-shaped filaments mentioned are not distributed in symmetrical order, but in a heterogeneous mass. This accounts for the mottled appearance of the sun, seen by the most common observer through a telescope. He would offer no hypothesis as to what the composition or the functions of this luminiferous envelope might be, but thought it had better remain till a great number of facts had been collected. His sole object was to introduce to the notice of scientific men the facts he himself had collected.

Mr. Nasmyth, in answer to some questions put to him, stated that he had used Sir John Herschel's eye-glass, of which he detailed the construction. The size of the willow-shaped filaments he should imagine, at a rough guess, to be 1000 miles long by 90 broad. The most suitable magnifying power for observing this phenomena is 200; for, as the air is seldom tranquil with a higher magnifying power, it is difficult to retain distinctness. The luminous tracts composing the outer envelope seem to be in motion among themselves, moving with enormous velocity; and when a spot upon the surface of the sun ceases to be so any longer, they come sailing across to fill up the space, like (said Mr. Nasmyth) a shoal of herrings.

Mr. Pritchard, one of the few who had observed these phenomena, differed with Mr. Nasmyth with respect to the difficulty of finding the air so favourable to seeing them. The real difficulty lies in seeing them first; but, having had them once pointed out, any observer could always recognise them. With regard to the size, too, he considered the smallest that he had ever seen to be larger than the whole continent of Europe. The smallest portion of the sun's disc, visible through the best telescope, must be at least 500 miles square. Mr. De la Rue saw them on a wretched day. Mr. Pritchard was convinced that the luminous tracts were solid, as liquids do not radiate. These float about heated, and from them we receive all the solar light and heat.

Section B.—Chemical Science.

This Section held its meeting in the Lecture-room, in the Old Botanic Gardens, at eleven o'clock, the Committee having met previously. Professor Miller, President of the Section, took the chair, supported by Professors Roscoe and Gladstone, Dr. Moffatt, E. J. Lowe, Esq., &c. &c.

Professor Miller, in a few remarks, briefly opened the meeting, and called on

Dr. Moffatt to read his paper on the "*Luminosity of Phosphorus.*" This paper treated of the vapour emitted from phosphorus, and of the luminous and non-luminous appearance of phosphorus. Dr. Moffatt said he had studied this subject for three years, and the substance of the results he had come to are given below:—Phosphorus changes under different atmospheric conditions. It be-

comes luminous when there is the south or equatorial current, and generally commences on the approach of storms and gales, and continues during unsettled weather, with frequent oscillations of the barometer. It is non-luminous at the setting in of the polar current, and continues during settled weather, with steadily-increasing readings of the barometer. Then followed the readings of the barometer during those periods. There is also a gaseous body formed by its contact with the atmosphere. On the luminous appearance of phosphorus certain diseases are prevalent, of which instances were given. It was stated that phosphorus was valuable as a disinfectant, as it gives oxygen to the products of decomposition; but only during the luminous period would it be effective. The paper concluded by stating the probability that atmospheric ozone is formed by the phosphorescence of bodies on the earth's surface, under favourable atmospheric conditions; that phosphorus is a source of magnetism, and perhaps the aurora itself will be viewed as a display of terrestrial phosphorescence.

There was no discussion on this paper.

The President next called on Professor Roscoe to read a paper by Thomas Sutton, B.A., on the "*Description of a Rapid Dry Collodion Process.*" The above is a problem, which has most interested photographers of late years, by which plates can be prepared as sensitive as with wet collodion. By the wet process, the negative has to be finished on the spot, a process which, of course, renders a quantity of paraphernalia necessary. To avoid this the photographer is obliged to work with dry plates, which is also attended with inconvenience, and the problem of a rapid dry collodion process has been solved by Mr. Sutton. The rapidity of this dry process depends upon the effect of bromine in dry collodion. In this process a silver plate iodised is extremely insensitive, but when submitted to the fumes of bromine it is increased a hundred-fold. In the wet, but not in this process, nitrate of silver is required, which is the element of instability. In preparing, therefore, rapid dry collodion plates, bromiodised collodion must be used. But the image produced thus is extremely thin and superficial; it is, therefore, necessary to apply to the film a coating of some organic substance, in order to darken parts of the negative. Many substances have been tried for this purpose, but all have failed in producing what bromine supplies. The paper concluded with the operations required for this purpose.

Mr. F. M. Lyte, of Christ's College, said that the system was not a fresh one. It was a modification of the resin process invented by the Abbé Despratz, and urged that it was far from satisfactory.

Mr. E. J. Lowe, F.R.A.S., F.G.S., &c., next read a paper upon "*Lowe's New Ozone Box.*" (See p. 186.)

Dr. Moffatt, of Hawarden, said he fully corroborated Mr. Lowe's deductions, and thought the paper a very important one; he conceived that it could not be too widely circulated. He had no doubt certain laws the author pointed out existed, and that certain corrections, as Mr. Lowe had said, would be necessary in reducing ozone observations; but Mr. Lowe had set himself a heavy task in taking and reducing these observations, as a long series of experiments were requisite. Mr. Eaton and Mr. F. M. Lyte also agreed with Dr. Moffatt on the interest of this paper. After a lengthy discussion, the President made a few remarks: first he pointed out to the members the ingenuity and simplicity of Mr. Lowe's invention, and concluded by expressing his conviction that the paper was one of great interest to Meteorologists.

The President next called on

Dr. Gladstone to read his paper on the "*Essential Oil of Bay and other Aromatic Oils.*" This paper consisted of a description of the essential oils, from whence they are obtained, of Bay, Bergamot, Carraway, Cassia, Cedar Wood, Cedrat, Citronella, Cloves, Indian Geranium, Lavender, Lemon Grass, Mint, Neroli, Nutmeg, Patchouli, Petit Grain, Portugal, Rose, Sandal-wood, Turpentine, and Winter Green (samples of nearly all the above were handed round), with their specific gravities, and powers of refraction, dispersion, and circular polarisation. Next followed some remarks on the isomeric hydro-carbons which may be derived from the majority of the essential oils, and which generally resemble one another very closely, though they are rarely identical. It also noticed some of the oxidised bodies present in these oils, which are generally more refractive and more chromatic than the hydro-carbons of which they are oxygen substitution products.

A short discussion took place on this paper.

The next papers were by Dr. T. L. Phipson, "*On the Existence of Aniline in Certain Fungi which become Blue in Contact with Air,*"—"*On the Artificial Formation of Populine, and on a New Class of Organic Compounds,*"—and "*On the Analysis of the Diluvial Soil of Brabant, known as the Limon de la Hesbaye.*" (These will be given in our next Number.)

Section F.—Economic Science and Statistics.

The first paper read was one of considerable practical importance, the subject of it being the "*Technical and Scientific Evidence in Courts of Law,*" and the author was the Rev. Vernon Harcourt, M.A.—The paper animadverted on the system pursued in our Courts of Law of allowing professional witnesses not only to state facts, but also to give opinions; and even the most scrupulous are inclined to follow the side which they are employed to support, while some not very scrupulous have been known to deliver opinions on points directly contrary to those they have been known to give previously under similar circumstances. The evil of this is very great, both as regards the reputation of public professions and the proper administration of the law. Many efforts had been made to amend the law relating to scientific evidence in courts of justice; and the Committee to whom the Section had entrusted the subject made the following recommendation:—"The Committee would therefore propose that, by a legislative act, Judges should be empowered, on application from a Suitor, in cases of a technical character, to convene skilled Assessors, the number of whom should be limited to three, and who should give their opinions on the statements of the witnesses, in such manner as they shall be required by the Judge, previous to his adjudication of the cause. A Court constituted as is here proposed might see a necessity in some cases for independent evidence of the facts on which either party relied. The allowing the Judge to call in witnesses independent of the parties in such cases, as is done on various occasions by Courts of Chancery, and by Parliamentary Committees, is a measure which has been suggested by a high judicial authority, and would, in the opinion of the Committee, be a valuable supplement to the preceding provision." In making these recommendations the Committee had regard to civil causes and not to criminal, as they thought that in the latter the opinions of witnesses were far less affected by partisan feelings. If the recommendations were adopted, the Committee proposed that they should be laid before the Home Secretary, with an application for his concurrence in carrying them into effect.

Mr. Heywood expressed his concurrence with the object of the paper, remarking that there could be no doubt that many cases involving a scientific investigation were brought before judges, who, however conversant with the law, knew nothing about the particular branch of science involved, and counsel, witnesses and jury were all equally ignorant of the matter; and the consequence was, that in a complicated case it was most difficult to arrive at a satisfactory result. The three assessors recommended by the Committee should of course be scientific men, and the judge should consult with them before coming to his deci-

sion. He thought this was not a matter in which money ought to be a consideration, for the proper adjudication of this subject was a matter in which the public at large had a great interest.

Mr. Tite supported the recommendation. He knew that there was a temptation to tell falsehoods in the witness-boxes in scientific cases; he had known a man come to his office and tell the truth, and then go to a Court of Justice, and feeling no such restraint as previously, state the case in an entirely different form.

Mr. Whiteside, M.P., asked whether it was proposed to do without juries?

Mr. Harcourt replied that it was contemplated to form the Court on the same system as the Court of Admiralty, and he believed that Court was constituted of judge and assessors, and that there was no jury.

Mr. Webster said it remained an open question as to whether there should be a jury.

Mr. Whiteside said that, in legal changes, great difficulty was invariably experienced to arrive at such a conclusion that the remedy should not be worse than the disease. Mr. Whiteside considered there was a great difficulty in supplementing the jury system in these cases, and in defining what the duties of the assessors should be. Regarding scientific wisdom in criminal cases, it was true that there ought not in such cases to exist any great difference of opinion, if the evidence was to weigh at all; but there was an immense amount of secret poisoning going on in the country which never came to light. He remembered, when he was Attorney General, that he had a case of poisoning which was fraught with considerable difficulty, but from which he learnt an invaluable lesson respecting vegetable and mineral poisons. As regarded these assessors, if they were to be of any use, they must have some power given to them; and then they might disagree, or fifty obstacles might arise. On the whole, while fully recognising the necessity of some steps for the amendment of the law, Mr. Whiteside did not fall in with the plan suggested.

Mr. Harcourt said the assessors were to be well qualified men, able to give an opinion.

The Right Hon. J. Napier said a similar thing occurred when the House of Lords called in the Judges for their opinions. He quite thought there ought to be a public prosecutor in criminal cases.

Prof. Hennesey said the plan might be carried out without interfering with the functions of the Judge. The Judge was the supreme authority in the law in the court in which he presided; but he probably knew nothing on the scientific points involved, in which the proposed assessors would guide him.

Friday, October 3.

Section B.—Chemical Science.

There was a very strong attendance in this Section. The chair was occupied by Professor Miller.

The first Paper read, which gave rise to some discussion, was one by Mr. G. B. Buckton, F.R.S., respecting "*Notes on the Decomposition of the Organo-Metallic Radicles.*"

Dr. Odling objected to some parts of the tabulated results as inaccurate.

A Paper was read by Monsieur Des Cloizeaux, entitled "*Modification Temporaire et Permanente Apportée par la Chaleur à Certaines Propriétés Optique du Feldspath Orthoze, de la Cymophane et de la Brookite.*" The Paper was followed by some interesting experiments by M. Des Cloizeaux, illustrative of the effect of heat on the properties treated of, which engrossed the attention of the gentlemen of this section for some time.

The President (Professor Miller) remarked, that when he first consented to take the chair, he thought this Section would be devoted solely to chemistry, and that there would be no mineralogy introduced. He, however, found out that he was mistaken, as mineralogy was treated of in a most effective manner, and he felt he had some better claim to his position.

PHARMACEUTICAL SOCIETY.

Wednesday Evening, October 1, 1862.

Mr. P. Squire, *President, in the Chair.*

This was the first meeting of the season, and as usual was devoted to the discussion of non-scientific matters, and the distribution of prizes to the pupils of the past session. The recipients of the prizes were as follows:—

Chemistry.—Mr. W. A. Tilden, medal; Mr. Whitfield, first certificate; Mr. Willsher, second certificate.

Botany and Materia Medica.—Mr. J. Whitfield, medal; Mr. Willsher, first certificate; Mr. W. A. Tilden, second certificate.

NOTICES OF PATENTS.

1935. *Process for Producing Colouring Matters or Pigments from Manganese.* W. E. Newton, Chancery Lane, London. A communication. Dated August 3, 1861. (Not proceeded with.)

For the preparation of the green oxide of manganese the inventor subjects the higher oxides to the action of reducing agents at a red heat, whereby products are obtained of a green colour and great brilliancy, suitable for the purposes of pigments.

1956. *Bleaching and Clarifying Saccharine Matters.* W. Clark, Chancery Lane, London. A communication. Dated August 6, 1861.

The improved processes of bleaching and clarifying the saccharine juices of the sugar-cane, beet-root, or other vegetable productions, consist in substituting for the granulated animal-black usually employed certain argillaceous substances—such as fuller's-earth, finely-powdered black shales, and similar minerals—used alone or in conjunction with a small proportion of the animal-black in the state of fine powder. These ingredients are introduced into the hot syrup, and kept in suspension by the use of a mechanical agitator, and by jets of steam escaping from pipes fixed beneath the level of the liquid under treatment.

The decolorising power exerted by the substances here enumerated has usually been described as being very far inferior to bone-black and peat charcoal. For the application in question the lower cost of the proposed substitutes will constitute an advantage, if their efficacy is at all comparable with the materials hitherto employed.

1978. *Treating Fatty and Oily Matters obtained from Wash Waters to Deprive them of their Smell.* L. Le Page, Merxem, near Antwerp. Dated August 8, 1861. (Not proceeded with.)

For the purpose of disinfecting and purifying the crude fatty matters recovered from the waste soap liquors of bleaching and dyeing works, the inventors propose to conduct through them, whilst in a melted state, sulphurous acid gas, or the lower oxides of nitrogen, as obtained by the reduction of nitric acid.

2013. *Treating Linseed and other Oils and Fats.* C. Binks, Gray's Inn, London. Dated August 13, 1861. (Not proceeded with.)

These improvements refer to the preparation of drying oils of superior character, especially in regard to colour;

and, in the second place, to the manufacture of the ordinary kinds of boiled oil with greater facility, by the employment of apparatus of novel construction.

2023. *Coating Wire with Gold, Silver, Copper, &c.* R. A. Brooman, Fleet Street, London. A communication. Dated August 14, 1861.

With the object of preventing the oxidation of iron and other metallic wire, the inventor claims a mode of covering the same with a coating of tin, brass, copper, silver, or gold, by electro-deposition in the following manner:—The clean iron wire to be coated is passed round a reel or pulley, which is in communication with the zinc terminal of a galvanic battery; then under one or more rollers immersed in a suitable metallic solution, in which also is placed a piece of silver or gold connected with the other pole of the battery, and which is constantly dissolving whilst the coating is formed upon the wire, immersed and passing through the solution; it then passes over a wooden roller or pulley outside the bath, and through a trough containing water, on emerging from which it is wiped dry by a cloth, and finally wound upon a roller to be used as required. The bath or solution before mentioned is prepared in accordance with the metal or alloy to be deposited.

Iron wire coated in this manner with gold preserves its tenacity, and is not liable to rust. Some beautiful specimens, prepared for the use of dentists and for photographic purposes, are shown in Class II. of the International Exhibition.

2031. *Improvements in the Manufacture from Steatite of Journals, Axle-boxes, and Bearings for Machinery, Axles, and Spindles; and also of a Lubricating Compound for Railway and other Carriages.* J. Bethell, King William Street, London. Dated August 15, 1861.

The patentee manufactures the bearings of machinery from steatite (French chalk), either powdered or in the natural massive condition. For the purposes of a lubricating agent the powdered steatite is purified from gritty particles by washing, and, if necessary, the oxide of iron is separated by digestion in concentrated hydrochloric acid and thorough washing with water. When dry, this purified material may be combined in any proportion with either of the oils, fats, or soaps already in common use for lubricating purposes.

Steatite, like black lead, would be best fitted for employment in the lubrication of parts of machinery which are occasionally exposed to excessive heat. For the ballast-trucks which deliver the charge into the blast furnace in iron works, at glass houses, in connexion with the casting table and gearing, and for a number of similar applications, the use of this material may be found advantageous; but for railway axles and engine bearings its efficacy is not so manifest.

2032. *Treating Bones.* J. C. Martin, High Street, Barnes. Dated August 15, 1861.

The system of treatment claimed by the patentee consists in employing hydrochloric acid, instead of sulphuric acid, for the manufacture of superphosphate and other soluble compounds containing phosphate of lime as the basis. The ground bones are digested in hydrochloric acid until the larger proportion of the phosphates are dissolved out; the acid liquor is then placed in contact with a second supply of bones, and left until saturation is complete. The solution is then evaporated to obtain a commercial superphosphate, suitable for manure, or the liquor may be partially neutralised with a base in order to obtain the phosphates in a precipitated form.

It is probable that, from the low cost of hydrochloric acid, this mode of treatment may come into successful competition with the older processes in which sulphuric acid is employed.

2053. *Composition to be Used as Fuel, and in the Lighting of Fires.* W. Bennett, London Street, Paddington. Dated August 19, 1861.

The patentee claims the manufacture of fire lighters and fuel by impregnating dried peat with melted resin.

A very similar composition, into which sawdust and nitre are introduced as additional ingredients, has been for some time in use under the name of "Patent Etna Fuel."

Grants of Provisional Protection for Six Months.

1516. Timothy Morris and RobertWeare, Birmingham, and Edward Henry Cradock Monckton, Fineshade, Northamptonshire, "Improvements in obtaining and applying light and heat by electricity."—Petition recorded May 19, 1862.

2154. Edward Beel Clark, Lower Polgooth, St. Ewe, Cornwall, "Improvements in the manufacture of candles, and in apparatus employed therein."—Petition recorded July 29, 1862.

2339. Adolphe Boubee, Paris, "Improved apparatus for casting or moulding glass and imitating precious stones or marbles."—Petition recorded August 21, 1862.

2410. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in coating or covering metallic surfaces with copper."—A communication from Charles François Leopold Oudry, Paris.—Petition recorded August 30, 1862.

2425. Joseph Mosheimer, Manchester, "Certain improvements in machinery for amalgamating gold and silver, or the ores thereof."—Petition recorded September 2, 1862.

2488. Frederic Hands and Henry Holland, Birmingham, "New or improved compositions for the manufacture of black ornaments, such as brooches, bracelets, ear-rings, and other ornaments usually made of jet, which said compositions may also be applied to the manufacture of various other articles."

2496. Thomas Steel, Bradford, Yorkshire, "Improvements in treating soapsuds or other saponaceous or oily matters."

2508. Peter Ward, Cloud Hill Villas, St. George's, Bristol, "Improvements in the manufacture of a double sulphide of calcium and sodium."

2518. Alexis Jean Moreau, Sherborne Street, Blandford Square, London, "An improved mode of, or process for, reducing or melting pulverised metals or metallic ores." Petitions recorded September 12, 1862.

2534. Henry Martin Radloff, Limehouse, Middlesex, "An improvement in vessels for filtering oil."—Petitions recorded September 15, 1862.

Notices to Proceed.

1483. Christopher Binks, Parliament Street, Westminster, "Improved methods of, and apparatus for, treating linseed and other oils and fats."

1496. Christopher Binks, Parliament Street, Westminster, "Improved methods of obtaining oxygen and chlorine gases."

1515. Timothy Morris, Robert Weare, and Edward Henry Cradock Monckton, Trafalgar Square, London. "Improvements in the means and apparatus for the protection of life and property by the agency of electricity."

1516. Timothy Morris and Robert Weare, Birmingham, and Edward Henry Cradock Monckton, Fineshade, Northamptonshire, "Improvements in obtaining and applying light and heat by electricity."—Petitions recorded May 19, 1862.

1550. Henry Cook, Manchester, "Improvements in electric batteries."—A communication from Professor Jean Minotto, Turin, Italy.

2062. Alphonse Cotelle, Saint Quentin, France, "Improvements in the manufacture of alcohol."—Petition recorded July 19, 1862.

MISCELLANEOUS.

Royal Institution of Great Britain.—The Lectures at the Royal Institution for the coming winter session have been arranged as follows:—Christmas Lectures, 1862: Prof. Frankland, six lectures, "On Air and Water" (adapted to a juvenile auditory). Before Easter, 1863: Prof. Marshall, twelve lectures, "On Physiology"; Prof. Frankland, ten lectures, "On Chemistry"; W. Savory, Esq., four lectures, "On Life and Death"; Prof. Max Müller, twelve lectures. After Easter: Prof. Tyndall, seven lectures; D. T. Ansted, Esq., nine lectures, "On Geology"; Prof. William Thomson, three lectures, "On Electric Telegraphy."

Webster's Process for Making Oxygen.—There are few chemical problems, a solution of which would be of greater commercial importance than the economical preparation of oxygen gas. By the kindness of the proprietors of the patent, we have been afforded an opportunity of critically examining every stage of the above process, and are therefore enabled, from personal observation and experiment, to endorse all the statements made by Mr. J. H. Pepper in the report which he has submitted. The gas is produced from materials of but trifling value, in large quantity, and by an operation requiring no skilled superintendence whatever. At first sight it would seem that the proportion of nitrogen present with the oxygen would tend to render the gas of only slight commercial value. A little consideration will, however, show that this is not necessarily the case. Although pure oxygen is invaluable in the laboratory, and at the lecture-table, its employment in an undiluted form would be impracticable in ordinary metallurgical operations on a large scale, as the intensity of its action would very soon rise to such a degree of violence as to reduce flux, fuel, metal, and furnace into one chaotic liquid mass. It is, indeed, very doubtful whether the mixed gas which is obtained in such abundance under this patent is not as strong as could be employed in most manufacturing operations without serious damage to the furnaces and crucibles used. The only case in which we believe a purer gas would be required is in the metallurgy of the more refractory platinum metals. The intensity of the "lime light" produced with this mixture is necessarily inferior to that obtained with pure oxygen, but it is abundantly sufficient for all ordinary purposes of illumination, and far better than we had anticipated from the composition of the gas. Indeed, it is only by comparing the two lights simultaneously, side by side, that the difference of intensity becomes apparent.

New Electrical Experiment.—M. Perrot, of Rouen, has made the following interesting experiment. In a glass vessel filled with oil, or other slightly conducting medium, he mixes by agitation particles of gold-leaf, which thus remain in suspension. Into this bath he plunges, at a distance from each other, two ball-conductors, conducting the one with an electric machine, the other with the ground. As soon as the machine is put in motion the currents are seen to form. The fragments of gold move towards the nearest sphere, and after touching it extend themselves towards the opposite ball. When these threads of metallic particles are carried out to a sufficient distance the two currents meet and are arrested, seemingly neutralising each other, and escaping laterally to return towards their respective balls. If this experiment be made in oil or any other viscid liquid the particles of gold dispose themselves in lines as regular as those of iron filings round a magnet. When the tension is feeble the lines formed by the gold particles going off from the two spheres unite in giving off a spark which illuminates the whole length of the metallic line. Sparks can be thus drawn out a hundred times the length of those got direct from the machine, and are obtained with scarcely any noise. M. Perrot thinks that in this we have an explanation of "heat lightning," as the silent summer flashes are commonly called, which, being produced without noise or tension, are thus to be distinguished from those producing thunder. The position of the neutral point between the two electric balls depends on the relationship of their respective surfaces. If the balls are equal, the neutral point is midway; if a point is placed opposite to a ball, the neutral surface establishes itself very near to the latter. This mode of experimentation will probably throw light on some electrical phenomena hitherto very obscure.

Diseases Produced by Fumes of Zinc.—Dr. Greenhow, in a paper lately read before the Royal Medical and Chirurgical Society, stated that this disease had first fallen under his observation during a brief holiday visit to Birmingham in the autumn of 1858, and he had subsequently been able on several occasions to investigate its history and causes in Birmingham, Wolverhampton, Sheffield, and Leeds. The symptoms have some resemblance to an imperfect paroxysm of ague; but they differ from it in this respect, that the paroxysms occur irregularly and are distinctly traceable to exposure to the fumes of deflagrating zinc. The attack commences with *malaise*, a feeling of constriction or tightness of chest sometimes accompanied by nausea. These always occur during the afterpart of a day spent in the casting-shop, and are followed in the evening or at bed-time by shivering, sometimes succeeded by an indistinct hot stage, but always by profuse sweating. The sooner the latter follows the setting in of the cold stage the shorter and milder is the attack, and the less likely is the moulder to be incapacitated for work on the following day. Headache and vomiting frequently, but by no means always, accompany the attack, which at the worst is only ephemeral; but the attacks are sometimes of frequent occurrence. Persons who have but lately adopted the calling, or who only work at it occasionally, and regular brass founders who have been absent from work for a few days, are more liable to suffer from this disease than those who work at it continually. The men themselves attribute this disease to inhaling the fumes of deflagrating zinc, and there can be no doubt that their opinion is correct. The remedy is to work in large, well ventilated brass foundries, and to employ a draught to conduct the zinc fumes out by the chimney.

Porous Waterproof Cloth.—This quality is given to cloth by simply passing it through a hot solution of weak glue and alum. To apply it to the cloth, make up a weak solution of glue, and while it is hot add a piece of alum, about an ounce to two quarts, and then brush it over the surface of the cloth while it is hot, and it is afterwards dried. Cloth in pieces may be run through this solution, and then run out of it and dried. By adding a few pieces of soap to the glue the cloth will feel much softer. Goods in pieces may be run through a tubfull of weak glue, soap and alum, and squeezed between rollers. This would be a cheap and expeditious mode of preparing them. Woollen goods are prepared by brushing them with the above mixture, first in the inside, then with the grain or nap of the cloth, after which it is dried. It is best to dry this first in the air and then in a stove-room at a low heat, but allow the cloth to remain for a considerable time to expel the moisture completely. This kind of cloth, while it is sufficiently waterproof to keep out moisture and rain, being quite impervious to water, is pervious to the air. Many fishermen know that, by boiling their pants, jackets, nets, and sails in a pot with oak bark and fish skins, and afterwards drying them, they become waterproof. The composition mentioned above is of nearly the same nature as the fish glue and oak bark, and consequently the same effects are produced. The composition is stated to be improved by adding about one-fourth the quantity of the sulphate of copper to the alum. Cloth made waterproof in this manner will resist the effects of water even if it is somewhat warm, but it loses its waterproof properties if boiled.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Mistaken Detection of Alum in Bread.

WE publish the following case as an illustration of the difficulties a chemist may get into by giving a rash opinion. A gentleman suspected that the bread supplied by his baker contained alum, and therefore forwarded three samples to a chemist for analysis. The report of the chemist was as follows:—

September 17, 1862.

"Dear Sir,—I have examined the samples of bread that you left for me at my house; they all contain alum, but No. 1 and No. 2 more than No. 3, as nearly as I can judge without having made a quantitative analysis. I do not find any other adulterations. The quantity of alum does not appear excessive, as compared with what is usually found in all bakers' bread; but I cannot speak confidently of this without making a quantitative analysis, for which purpose I should require a larger quantity—say one pound of the bread. If you wish me to make the quantitative analysis, I shall be happy to do so on the receipt of a fresh sample.

"Yours respectfully,

"Fee for analysis, £1 1s. ****, F.C.S."

The above was explicit enough; the bread did actually contain alum. On receipt of this report the gentleman took out a summons against the baker, and requested the attendance of the chemist at the hearing. The baker, knowing that no alum had been used by himself or his servants, on receiving the summons, took two samples of flour to the same chemist, and the flour also was reported to contain alum.

"September 25, 1862.

"Sir,—I have examined the samples of flour you left with me, and find that both contain alum.

"Yours, truly, ****."

Upon this the baker took out a summons against his miller. Apparently with some misgivings as to the accuracy of his results, the chemist suggested, but afterwards withdrew the suggestion, that it would be as well to examine some flour which he would grind and prepare himself. Before, however, the summonses came on for hearing, he did so, and here is the report which was sent to the gentleman from whom the bread was received:—

"September 27, 1862.

"Dear Sir,—On further consideration, I have thought it undesirable to leave any possibility of error unexplained, and have, therefore, prepared a sample of flour from wheat by grinding it myself. On subjecting the flour so obtained to the same process of analysis as that adopted for the other samples, I find, much to my surprise, that I obtain like indications to those considered to prove the presence of alum, although I know there is none present in this sample. As the same process was employed for the examination of the bread, I shall not be able to maintain the correctness of my results. Will it not, therefore, be better to adjourn the case until I can make another examination by a different process, to which objections may not be raised?

"I have sent this by my son, who will be able to explain to you in detail what I have done.

"He will also call on ——, and get him to take the necessary steps to prevent the attendance of his witnesses, and to suspend the summons served on the miller. Should my son not see you, I shall not go to —— on Monday, unless I hear from you.

"Yours, truly, ****."

On the Monday, the gentleman to whom the above was sent (a barrister, by the way) attended before the magistrates to ask for the dismissal of the summonses. In the course of his remarks, he said that he did not wish to comment on Mr. ——'s letters; the public and scientific men would read them, and form their own opinions. He would only say either that Mr. —— could not have applied the proper tests, or, if he had, the flour to which tests was applied must have been steeped in alum water, or the proper and approved tests were insufficient and not to be relied on. He could scarcely think that in the nineteenth century, when science had so advanced in all its branches, not omitting analytical chemistry, scientific men would be satisfied with such a test of the existence of alum in bread or flour, as might be applied with the same results to those articles in their adulterated or unadulterated states. Surely, the first principle in establishing the efficacy of any test was to apply it to the articles unadulterated as well as adulterated, and to watch the different results. He made this statement that the public might learn, if Mr. ——'s recantation was correct, how unsatisfactory the approved tests in these cases was; and he only hoped the magistrates would think he had, in the circumstances of the case, discharged his duty.

The Bench said they entirely exonerated the baker, and dismissed the summons.

The above case requires no comment. Mr. —— is probably not the only chemist who has made a mistake when examining bread for alum; and what can we think of the results obtained by individuals who are not chemists? One word as to the manner in which we have reported this case. When a legal practitioner is accused at Westminster of a transaction which would probably have ended in the transportation of an unprofessional man, the legal gentlemen who report for the daily papers in the superior courts are in the habit of sheltering their peccant brother from infamy by suppressing his name, and reporting the proceedings as "In re ——, an attorney." We make no excuse for adopting in this instance a similar course, and only hope that the case may serve as a warning to less competent men than the gentleman here concerned.

On the Preparation of Metallic Barium, by William Crookes.

In the last number of the *Philosophical Magazine* will be found a note by Mr. C. W. Vincent on the preparation of chromium, and one by Mr. W. B. Giles on the preparation of manganese; the reduction in each case being effected by allowing sodium-amalgam to act upon an aqueous solution of the respective chlorides, removing and drying the new amalgam which forms, and then distilling off the excess of mercury. It may be interesting to know that this method is capable of very general application. Not only can salts of most of the heavy metals be reduced to the metallic state in this way, but also those of the alkaline earths. The preparation of barium is especially easy. To a saturated aqueous solution of chloride of barium sodium-amalgam is added. The whole is then heated to about 200° F., and in a few minutes the replacement of sodium by barium will be complete. Scarcely any gas is evolved, but the amalgam increases in bulk, becomes of an iron-grey colour, and, upon examination with a lens, is seen to consist of a mass of glistening metallic crystals. In order to make sure of the removal of the whole of the sodium, the supernatant liquid may be poured off, and the amalgam boiled with fresh chloride of barium. A little hydrogen will now be evolved, and the barium amalgam must be transferred to a dish of water, and kneaded with the fingers under a tap for a minute or so, to get rid of salts. It must now be dried and squeezed in a cloth, to remove excess of mercury. In this state barium amalgam forms a very heavy crystalline mass, which, when kneaded between the fingers, has very little cohesion, but breaks up with a grating sound into a crystalline powder; it tarnishes slowly in the air, and decomposes water.

To prepare the pure metal from this, it is placed in a hard glass tube retort, and covered with naphtha, the open end of the tube being nearly closed by a cut cork; the naphtha and the mercury are then distilled off, the heat towards the latter part of the time being raised to redness by a blow-pipe. The barium rapidly attacks the glass at this temperature, and if this temperature be maintained too long the resulting metal will contain silicium. The tube is then allowed to cool, and the end cut off. The metallic barium will form a fused mass at the end of the tube; it must be quickly removed to naphtha, as it appears to tarnish as readily as potassium. To get the true colour of the metal it must be scraped under naphtha; it will then be seen to possess a brilliant white, metallic lustre. Exposed to the air for even a few minutes, it crumbles to powder, which gradually becomes white, consisting then of baryta; thrown into water it sinks instantly, evolves hydrogen violently, and forms baryta-water. When heated in a spirit-lamp it burns like iron filings, the light being a mixture of red and green. The properties of the metal are in these, as well as in other, respects, identical with those given by Sir Humphrey Davy.

On the Composition of a Specimen of Fossil Wood from the Green Sand of the Isle of Wight, by Dr.* T. L. Phipson, *F.C.S., &c.*

The quantity of phosphoric acid which is diffused throughout the cretaceous formations of England is not only surprising, but very difficult to account for. This quantity appears to reach its maximum in the fossils distributed through the strata, especially in those of the upper and lower green sands. A magnificent specimen of fossil wood from the green sand of the Isle of Wight was forwarded to me a short time ago for analysis. It is of a brown lignite tint, sp. gr. = 2·71, may be cut with a knife like slate, and resembles in appearance ordinary petrified wood. Its composition is, however, very different; it contains nearly 70 per cent. of phosphate of lime. A complete analysis has given me the following figures:—

Water	11·00
Organic matter	6·62
Sand, &c.	4·40
Lime	38·52
Magnesia	1·00
Phosphoric acid	32·43
Fluorine	3·90
Chlorine	traces
Sulphuric acid	traces
Oxide of iron, oxide of uranium, pyrites, and loss	2·13
	100·00

This composition shows that the fossil wood in question is a kind of apatite or pseudo-apatite; it is not phosphorescent by heat, like most varieties of apatite. It shows here and there crystals of wavellite and of iron pyrites. I should state here that Messrs. Way and Paine have analysed specimens of fossil zoophites, sponges, shells, &c., from these strata, and they present a somewhat similar composition to this fossil wood.

* Read before the British Association.

On the Existence of Aniline in Certain Fungi, &c., by Dr.* T. L. Phipson, *F.C.S., &c.*

In this paper the author refers to some experiments upon the action of organic matters upon oxygen, which he published about two years ago, and which tend to show that, whenever an organic substance is oxidised in nature, the oxygen is in the state of ozone. This state is excited by the presence of a ferment. For instance, when an apple is cut in two halves, the tissue exposed to the air becomes brown in a short time; this coloration is owing to ozone acting upon the tissue. Ordinary oxygen will not produce it; moreover, the presence of a ferment in the tissue is necessary to ensure the transformation of oxygen into ozone. If a solution of guaicum, or of iodide of potassium and starch, is placed upon the freshly-cut surface of the apple, these reagents immediately show the presence of ozone. If the apple be heated to 100° C., so as to destroy the ferment, no ozone is formed, and the coloration will not occur. The author then proceeds to examine the cause of the coloration of certain fungi (*Boletus luridus, Boletus cyanescens, &c.*), which become blue when they are cut and exposed to the air. This coloration is also due to the action of ozone, induced by the presence of a ferment; and the substance upon which the ozone acts appears to be acetate of aniline. Alcohol extracts the latter, together with a variety of other substances, which, however, do not prevent the characteristic reactions of aniline, such as the action of chloride of lime, &c., to be distinctly obtained with this liquid. When the fungi are previously boiled to destroy the ferment, no ozone is formed in contact with the air, and, consequently, no coloration occurs. The author states that Professor Schoenbein first remarked that ozone was active in the coloration of these fungi.

* Read before the British Association.

TECHNICAL CHEMISTRY.

Note on the Purification of Pyroxilic Spirit, by Harry Napier Draper, *F.C.S.*

In a case (No 513, Class 2), in the Exhibition at South Kensington, is to be seen, or was to be seen last August, a large glass jar, containing, perhaps, the most remarkable of the many products of modern chemistry which constitute the attractions of the Eastern Annexe. Just at this time, in its connexion with a subject of vital importance to pharmaceutical chemists, this single bottle should be to them the most interesting object in the entire chemical collection; and yet, although I have been not a little surprised that, beyond a mere passing notice in the Chemical News of its existence, it has been wholly overlooked, those who read this note will be still more astonished that it should not before have attracted attention in connexion with the vexed question of "cleaned" methylated spirit.

This bottle holds, perhaps, a gallon of fluid, and has a boldly-printed label, "Potable Wood Naphtha." Through the courtesy of the Class Superintendent, I obtained a specimen of this liquid, large enough to serve for several experiments, and to leave sufficient to satisfy the curiosity of any one who may wish to see it. It is colourless, its odour suggests nothing but alcohol, and its taste but the very faintest suspicion of pyroxilic spirit. It has a specific gravity of ·805. When diluted, both the smell and taste of wood-spirit become more perceptible; but so little so, that the slightest addition of an aromatic essential oil is enough to conceal them. I am convinced that there is no single tincture in the Pharmacopœia which, if made with this spirit, could be distinguished from the officinal preparation by its sensible properties.

I ascertained, upon further inquiry, that this spirit was prepared under a patent, taken out during this year; and, as I have a copy of the specification before me, I will give an outline of the patentee's method of "Treating Wood and other Vegetable Spirit," premising that the specification offers no evidence that the patentee considered wood-spirit as anything but some very impure form of ordinary alcohol, which, like that prepared from beet-root and madder, it would be desirable to render potable. Specimens of beet and madder spirit are, in fact, exhibited in the same case.

The wood-spirit is first diluted with from 75 to 80 per cent. of water, allowed to repose for twenty-four hours, and then passed through a succession of filters containing coarsely-granulated wood charcoal. The only novelty claimed by the patentee is the very ingenious arrangement of the filters, which are so placed that the spirit in the process of purification shall continually come in contact with cleaner charcoal, and that one, the first of the series, can be replaced when foul by a new one, not in its place, but as the last of the series. After purification, the spirit is of course distilled.

An experiment on the small scale with a series of seven filters—the patentee recommends fifteen—gave spirit nearly as free from taste and smell as that which I obtained at the Exhibition, and I have little doubt that even the latter can be still further deodorised.

Pure methylic alcohol has hitherto been believed to possess, as a reference to any treatise on chemistry will demonstrate, an odour and taste peculiar to, and inseparable from, itself. Resting upon this hypothesis, and upon its remarkable chemical analogy to vinic alcohol, the Excise authorities felt themselves secure in permitting the untaxed sale of ordinary alcohol, which had been mixed with the methyl compound. "In fact," write Messrs. Graham, Hoffman, and Redwood, in their report on the subject to the Chairman of Inland Revenue,* "the more highly purified the naphtha is with which the spirit is mixed, the more difficult will it be to effect the alteration of this mixture in the way contemplated by any chemical process."

But this hypothesis is now, I submit, no longer tenable. We have in this specimen in the Exhibition, in the specification of the patentee who exhibits it, and which details minutely a process which any chemist can successfully repeat, and in the undeniable fact, that "cleaned" methylated spirit is an article of every-day application, proof that not only can the mixture, containing but 10 per cent. of methylic alcohol, be successfully purified, but that wood-spirit itself, as found in commerce, can be made to so closely resemble wine alcohol, as to be, when undiluted, indistinguishable from it, save to the most sensitive and tutored smell and taste.

Now, while I am of opinion, that in its present form, the patenteed process just described is not adapted to the purification of wood-spirit on a manufacturing scale, I cannot avoid also expressing my belief, that Mr. Phillips, when deprecating the danger arising to the revenue from the possibility of rendering methylated spirit potable, adopts too confident a tone. It would have been thought scarcely necessary to remind any one who knows what has been the progress of chemical science during the past ten years, that that which to-day is only practicable as a laboratory experiment, may to-morrow, by some simple modification, become not only practicable on a large scale, but a profitable field of manufacturing enterprise. Nor is it probable that, in the face of the indignant letters which have thronged the pages of the *Pharmaceutical Journal* for the past three months, the chemist of the Inland Revenue would write in October as he did in March, alluding to some discarded patent having a like object—that there are considerations of a recondite nature "which alone would lead me to doubt that danger to the revenue would accrue from the process in question."†

Turning aside, however, from the unpleasant part of the subject, it is satisfactory to find that a process having a wholly practical object points to a new scientific truth. It is impossible—it is so to me, at least,—to avoid the conclusion, that the body which is described by chemists as methylic alcohol, is methylic alcohol *plus* a minute quantity of a strongly odorous hydrocarbon (probably the same which exists in the crude wood-spirit to a large extent), which has so great an affinity for the alcohol, that not only does the ordinary process of purification, by dilution with water and distillation, fail to remove it, but that the most powerful oxidising agents are equally unsuccessful. If the dilution, however, be followed by an interval of repose, and that then the fluid be percolated through charcoal at a low temperature, and in such a manner that the partially-purified filtrate shall not redissolve the separated hydrocarbon, the result is a body which, while we can no longer attribute to it the peculiarities of taste and smell by which methyl-alcohol is now recognised, and which it is described by chemical writers as possessing, is still methyl-alcohol in all its chemical characteristics and reactions.

* *Vide Pharm. Jour.*, Vol. xv. p. 30.

† *Vide Pharm. Jour.*, Vol. iv. (New Series), p. 171.

I have yet to complete researches, with the object of placing this hypothesis beyond dispute; but as just now the subject possesses more than ordinary interest, I have thought it well to state the conclusions at which I have already arrived.

Dublin, October 11, 1862.

On Artificial Stones, by Professor* D. T. Ansted, *M.A., F.R.S.*

The various compositions that have been invented from time to time to replace natural stone, by substances cheaper, more convenient, or more durable than any that can readily be obtained on the spot where the stone is required, are so numerous that it would be impossible merely to name them without occupying much time, and a mere enumeration could have little or no interest. My object in the present communication is to direct the attention of the Section to the different classes of material that have been found available; to point out the principles involved in each, and the special advantage and disadvantage each possesses; to refer to a new, and, I believe, an important material, and to suggest the bearing of the whole subject on that of the preservation of stone from decay. Having for several years, and especially during and since the Exhibition of 1851, taken great interest in the subject of constructive material and the preservation of stone, and having lately been one of a Committee of Inquiry concerning the state of the stone of the Palace at Westminster, I have learnt from experience how little the whole subject is understood, how vague are the notions of intelligent practical men—builders as well as architects—and how difficult, if not impossible, it is for architects, engineers, and builders to determine, by any series of experiments lasting only for a short time, whether a method proposed is likely to have any practical value when applied on a large scale.

The artificial stones hitherto used may be grouped under one of three heads; they are either (1) terra cotta, or manufactures of plastic clay burnt in a kiln; (2) cements, manufactured from a certain kind of limestone, containing foreign ingredients of such a nature that, when converted into lime by burning, the lime thus made possesses the property of setting very rapidly and firmly when wetted; (3) siliceous stone, obtained by burning in a kiln sand and other substances moulded with a solution of silicate of soda, which is converted into a kind of glass firmly connecting the particles. I omit plasters, as rarely exposed to the weather.

Terra Cotta.—The advantages of this material are (1) its cheapness, and the abundance and the universal distribution of the clays of which it can be made; (2) the facility with which it can be moulded to any required form; and (3) the pleasant colour of the material when uninjured by long exposure to weather. The work recently executed at the Horticultural Gardens at South Kensington is a favourable specimen. The disadvantages of terra cotta are (1) the uncertainty of the result, owing to the great and unequal contraction of all clays in burning; (2) its want of power to resist damp and frost whenever there is the slightest flaw, whether produced before or after burning; (3) its brittleness and want of strength; (4) its exposure to a disagreeable green vegetation in damp air after a few years' weathering. Terra cottas are better adapted to a dry than a moist climate.

* Read before the British Association.

Cement.—Whether of the kind called Puzzolana, Roman, or Parker's, or Atkinson's, or any modification of these, all the cements are similar in their nature. The advantages of cement used as an artificial stone are (1) its cheapness where made, and its ready transport; (2) its not requiring the kiln, but setting at once without contraction; (3) the facility of moulding and making up the material from the manufactured cement supplied; (4) its great strength when well made. The disadvantages are (1) that it cracks and peels badly when exposed to frost and damp air; (2) that it is very irregular, some samples yielding a much harder, better, and more lasting stone than others, without apparent reason; (3) that it is subject to a green vegetation, like terra cotta. These disadvantages do not all apply to its use in making concrete, for which it is admirably adapted.

Siliceous Stone.—This is manufactured under a patent by Mr. Ransome. It attracted attention at the Exhibition of 1851, and has since been much used. Its advantages are: (1) the extreme uniformity of its texture; (2) the almost entire absence of contraction, and its freedom from cracks and flaws produced during burning; (3) its complete resistance to all kinds of weathering, to which may be added (4) its pleasing colour and tint.

On the other hand, among the disadvantages are (1) its cost, which is greater than for either of the other kinds of artificial stone; (2) its being subject to a white efflorescence of salt and a green stain from damp, both of which take away from its value for ornamental purposes, for which it is otherwise admirably adapted.

The mechanical and chemical principles involved in these different contrivances are as follows:—In terra cotta the material is a kind of clay purer and more free from foreign substances than common clay, and mixed with dust from pottery already made. The manufactured article is thus a superior fire-brick. The burning produces little chemical change or metamorphosis, but the condition after burning is so far different that ordinary exposure will not bring back the original texture of clay. Of closer texture than brick, there is less absorption from the surface; but in ornamental work there are always flaws enough to render frost following rain dangerous and injurious. In other respects the material itself is little more liable than brick to injury from exposure.

In cement the raw material is carbonate of lime, with a certain but variable proportion of foreign substances, of which clay or silicate of alumina is an important and even an essential part. All the varieties of cement stone, such as the stones called septaria and other nodules, in the London clay at Harwich, or the Kimmeridge clay in Dorsetshire, or the Lias in the Midland Counties and the north, or the mud of the Medway and Thames, agree in this. On burning this material the limestone is converted into lime, and the condition and proportion of the foreign material determine the value of the resulting cement. It is called *hydraulic cement*, as setting with almost any required rapidity when properly mixed with water, and this in damp air, during rainy weather, and even under water, absorbing no more water than is necessary for consolidation. Under various names, *pozzuolana*, Roman cement, Parker's cement, Atkinson's cement, &c., this valuable material has been used from time immemorial, and is especially adapted for making concrete where a large proportion of foreign substances is introduced. As an artificial stone, although it hardens on exposure, its composition is too irregular to justify a very extended use. In the process of setting,

the lime first mixes with water and becomes hydrate of lime and is then rapidly converted into silicate of lime, adhering strongly in thin films to itself and to foreign bodies with which it is in contact.

The siliceous stone of Mr. Ransome consists of sand and foreign substances, worked up into a paste with the fluid silicate of soda. If left to dry in the air it would fall to powder, but being exposed to a high heat in a kiln a chemical action takes place. The alkali of the silicate of soda "combines with an additional quantity of silica supplied by the sand, &c., with which it is incorporated, and becomes converted into an insoluble glass, firmly agglutinating all the various particles together into a solid, compact substance." No sensible contraction takes place in burning, and cracks rarely occur.

The resistance to weather offered by these three kinds of artificial stone may be thus stated:—1. Terra cotta, contracting irregularly in the kiln, is subject to cracks and flaws, into which water penetrating and expanding during frost, a peeling and splitting of the material naturally follow. It is almost certain, from the nature of the case, that delicate and ornamental work should be more liable to such injury than straight work and plain surfaces. 2. Cement, owing to the want of homogeneity in the raw material, is also very subject to flaws and cracks, and is injured by damp and frost like terra cotta. Both terra cotta and cement require painting in London and elsewhere. 3. The siliceous stone is rarely flawed in the kiln, but even if it is, the stone does not crack, or the surface peel by exposure to damp and frost, owing to the nature of the cement, which is, in fact, glass. It is also worthy of remark, that this material obtains its greatest hardness before it leaves the kiln, whereas cement gradually hardens, and continues to harden for many years if it be not destroyed before the induration is sufficiently advanced.

During experiments made in the laboratory on various methods suggested for preserving stone, by a section of the committee recently appointed by the Board of Works in reference to the Palace at Westminster, Dr. Hoffman, Dr. Frankland, Mr. Abel, and myself, being members of this sub-committee, a very remarkable material was submitted by Mr. Ransome and experimented on to some extent.

Dr. Frankland has since reported on this material. Its discovery arose out of the application of Mr. Ransome's method of preserving stone by effecting a deposit of silicate of lime within the substance of absorbent stones:—Mr. Ransome saturating the surface with a solution of silicate of soda, and then applying a solution of chloride of calcium, thus producing a rapid double decomposition, leaving an insoluble silicate of lime within the stone, and a soluble chloride of sodium (or common salt), which could afterwards be removed by washing. To prove that by this process a coating of hard silicate of lime was actually formed and deposited, as according to his theory it must be, Mr. Ransome made small blocks of various forms, in moulds, by mixing loose sand with the fluid silicate of soda, and then dipping the mould into the chloride of calcium. To the surprise probably at first of Mr. Ransome himself, but certainly of the chemists of the sub-committee, who performed the experiment in the absence of the inventor, there came out almost instantaneously a perfectly compact, hard, and, to all appearance, a perfectly durable solid. In such solids, at least, there seems to be no element of destruction.

It was evident that such a result could not be without consequences. So far as it bore upon the inquiry of the committee, it is alluded to in their published report. Many considerations connected with the nature and condition of natural stones liable to destruction by weathering prevent an absolute decision without much previous experience. Mr. Ransome, however, immediately patented his "concrete stone," and as an artificial stone it deserves to be well known and thoroughly considered. It promises, indeed, to combine the advantages, and seems to show none of the disadvantages, of other artificial stones. It is cheap, being made of almost any rubbish on the spot where it is required, by the aid of materials neither costly nor difficult to convey. It is made with rapidity, and is ready for use without drying or burning. It hardly requires even a temporary shed for the purposes of manufacture, and may be made of any size, and moulded into any form. So far as can be detected, it is subject to no injury from weather, and becomes, in fact, if made with sand, a true sandstone, cemented by silicate of lime, than which there is no better natural material. No doubt it will be necessary to watch carefully for a few years the behaviour of a silicate of lime thus deposited; but if it endure that test, there can be no doubt that it will then improve by time, increased age only hardening all known silicates of lime, especially those formed from lime used as mortar or cement.

In the application of this subject to the preservation of stone, there seems a probability that some valuable result will follow from the suggestion of Mr. Ransome, to effect the deposit of an insoluble silicate within the pores of an absorbent stone by double decomposition. The objection, strongly felt, that the material thus deposited would probably be in the form of unconnected grains, rather than a cementing film, seems answered by the formation of a stone so solid as the specimens show; and although it is unlikely that any contrivance can render absolutely permanent a stone that has once advanced far in decay, it will be a great step gained if poor and doubtful stones can be rendered almost indestructible before being placed in a building and exposed to danger.

So far as artificial stone is concerned, Mr. Ransome's material, if it really shows no unexpected weakness, will answer all requirements. It has been tried on a somewhat large scale in the bed of a steam engine, weighing two tons, in the International Exhibition, and again in the new stations recently erected for the Metropolitan Railway. Smaller specimens are very satisfactory. It seems to combine cheapness with durability and resistance to weathering to an extent hitherto unknown.

I append the following results of experiments recently made, and communicated to me by Mr. Ransome:—

Compared with Portland and Caen, a bar of the concrete stone, the section being 4 inches square, and length 8 inches between the supports, sustained 2122 lbs. suspended midway between the supports; while Portland and Caen broke at 750 and 780 lbs.

The adhesion of the stone is shown by weight suspended from a piece prepared to express a sectional area of $5\frac{1}{2}''$. Caen stone separated at 768; Bath at 796; Portland at 1104; Elland Edge at 1874; and Ransome 1980 lbs.

A cube of 4″ sustains 30 tons.

PHARMACY, TOXICOLOGY, &c.

The Action of Chromic Acid on Vegetable Alkaloids, by J. J. André.

(*Continued from page* 177.)

Neutral Chromate of Cinchonine.—Having obtained basic chromate of quinine, there seemed to me

nothing easier than to produce basic chromate of cinchonine by the same process; but on this point I found myself entirely at a loss. When basic sulphate of cinchonine is dissolved in water, and neutral chromate of potash added to the solution, a yellow precipitate is immediately formed; on heating the balloon in which the experiment is carried on, the sides of the glass become covered by an infinity of small, white, sandy crystals, but the greater number are precipitated to the bottom of the balloon. From light yellow the colour of the liquid changes to orange yellow. After filtering, the liquid, if sufficiently concentrated and left to cool, deposits the next day, or the day after, a certain quantity of small crystals disposed in rays; in this way, not basic chromate, but neutral chromate of cinchonine, will be obtained. The white crystalline substance remaining on the filter is very slightly soluble in water. After being washed and freed from all trace of sulphate and of chromate, there appears a great quantity of small prismatic crystals, reflecting light vividly. The salt dissolves very well in dilute acids, and its aqueous or alcoholic solution turns red litmus paper blue; it is, in short, cinchonine.

To explain this curious reaction it is necessary to admit that, as soon as the two solutions of sulphate of cinchonine and neutral chromate of potash come in contact, the cinchonine divides, and a portion of it is eliminated when abandoned by the sulphuric acid with which it was united; this takes half its base from the neutral chromate, changes it to bichromate of potash, as is shown by the deepened colour of the liquid, and all the acid of the bichromate joins the other equivalent of cinchonine, and so forms a neutral chromate.

The same reaction takes place at the ordinary temperature. By pouring 1 part of the salt to 100 parts of water, with some neutral chromate of potash dissolved in ten times its weight of water, into a solution of sulphate of cinchonine, the mixture immediately takes the colour peculiar to bichromate of potash; it thickens, and then deposits a precipitate formed in two strata—the upper stratum of neutral chromate of cinchonine being yellow orange; the lower one of cinchonine white.

Neutral chromate of cinchonine exists in the form of birefracting acicular crystals, of an orange yellow colour, soluble in 80 parts of boiling water, very alterable by light, or by a temperature above 60 degrees.

Neutral chromate of cinchonine is easily obtained by dissolving 4 parts of sulphate of cinchonine in 300 parts of water, to which a few drops of diluted sulphuric acid have been added; then raising the temperature to 60 degrees, and adding 12 parts of a solution of bichromate of potash. After forty-eight hours the mother waters are decanted, and the deposited crystals washed and dried carefully to prevent their undergoing alteration. Like all the chromates of alkaloids, which cannot stand the action of the light, they are preserved in yellow-glass bottles.

As cinchonine does not form basic chromate, it can combine directly with chromic acid; it is only necessary to take a very weak solution of this acid, and to add to it, whilst raising the temperature 60 degrees, recently precipitated hydrate of cinchonine; after filtering, to separate the excess of hydrate, and cooling the solution, crystals of neutral chromate of cinchonine are deposited, in every respect similar to those of bichromate of potash.

Neutral Chromate of Quinidine. — Quinidine, under the influence of chromic acid and chromates of potash, behaves exactly like cinchonine. Neutral chromate of quinidine crystallises in very short, radial needles; the crystals are orange red; they are nearly as soluble as those of neutral chromate of cinchonine, more so than those of neutral chromate of quinine; they are also readily acted on by light.

The bipartition of cinchonine and quinidine, under the influence of neutral chromate of potash, allows these alkaloids to accompany the basic chromate of quinine, in whose solution they dissolve at boiling heat. What happens, in fact, in preparing basic chromate with commercial sulphate of quinine, which always contains some centièmes of sulphates, whether of cinchonine or quinidine? The cinchonine or quinidine is, as we have shown, eliminated by the presence of neutral chromate of potash; these alkaloids dissolve as soon as the basic chromate of quinine begins to boil, as I have proved by experiment, and afterwards crystallise with the chromate, which they render rather more basic. The neutral chromate of cinchonine or quinidine produced during the reaction remains in the mother waters. To prevent the chromate of quinine from becoming superbasic, a tenth of bichromate solution may be added to the solution of neutral chromate of potash: this addition preventing the division of the cinchonine or the quinidine, which may be mixed with the sulphate of quinine, a perfectly pure basic chromate of quinine will be obtained. I mixed sulphate of quinine with 20 per cent. of sulphate of cinchonine or quinidine, treating it, as shown above, by solutions of neutral chromate of potash and of bichromate, of which, in this case, I used a sixth part. By this means I succeeded in easily separating cinchonine or quinidine. By-and-by I purpose to ascertain whether it is possible to render this process practicable for the commercial estimation of sulphate of quinine.

Bichromate of Strychnine.—The salts of strychnine, such as its sulphate and hydrochlorate, give the same reactions as cinchonine and quinidine, when their solution is mixed with that of neutral chromate or bichromate of potash. While trying to obtain chromate of strychnine I had an opportunity of proving for the first time the destructive action of light on most of the chromates of alkaloids. The precipitating vessel in which I mixed the solutions of sulphate of strychnine and chromate of potash, happening to be placed before a very well-lighted window, I remarked that the portion of the deposit nearest the window was coloured orange red, while the part furthest from the window remained orange yellow. To prevent this kind of alteration I was obliged to work only by a dim light, and to dry the products in the dark.

Chromate of strychnine is prepared by dissolving 4 parts of sulphate of strychnine in 1200 parts of water, acidulated with a little sulphuric acid; the solution is boiled, and 12 parts of a solution of bichromate of potash are poured into it; the bichromate of strychnine crystallises by cooling. In MM. Pelouze and Frémy's *Traité de Chimie Générale* there is a description of the preparation of a chromate of strychnine by means of a mixture of neutral chromate of potash and hydrochlorate of strychnine, which process can give only a mixture of strychnine and of bichromate of this base. The chemist who attempted this reaction had imperfectly studied the results, and the formula he gives of this salt—

$$C_{42}H_{22}N_2O_4.CrO_3.2HO$$

is inexact; it contains two, and not one equivalent only of chromic acid.

Well crystallised bichromate of strychnine is in the form of needles, sometimes 3 millimètres long, of a beautiful orange yellow colour, bordering on red, reflecting light vividly, of micaceous appearance when the crystals are very small. Except basic chromate of quinine this

is the least soluble alkaloid chromate; it shares this property with acid sulphate of strychnine, which is much less soluble than its neutral chromate. Concentrated sulphuric acid put in contact with bichromate of strychnine dissolves and takes a beautiful blue colour, then violet, and finally passes to red; it behaves in the same way as sulphate of strychnine, to which pure oxide of lead and concentrated sulphuric acid have been added. Has the nature of strychnine, in the form of bichromate, been changed, or undergone some modification? To elucidate this question I decomposed a certain quantity of this salt, dissolved in water, by means of a solution of neutral acetate of lead; by this reaction insoluble chromate of lead was formed, which I separated by filtration; the filtered liquid, containing acid acetate of strychnine, was evaporated. The crystals of acetate of strychnine, resulting from the evaporation, moistened with a few drops of concentrated sulphuric acid, underwent no apparent change, but on the addition of a few drops of chromic acid or bichromate of potash, the blue colour appeared directly.

Chromates of Brucine.—Brucine will combine in two proportions with chromic acid, by means of neutral chromate or bichromate of potash.

Neutral Chromate of Brucine.—Obtained by saturating 2 parts of brucine with weak sulphuric acid, after having suspended it in 200 parts of water at 45°; then adding 10 parts of solution of neutral chromate of potash. In a very short time crystals of neutral chromate of brucine make their appearance, of a brilliant light yellow colour, composed of small birefracting prisms; diffused light affects them very little; exposed to the sun they become gradually brown, without changing their shape, and take a garnet colour.

Bichromate of Brucine.—Obtained by double decomposition, or directly by chromic acid. It occurs in the form of small, micaceous-looking, orange-red crystals, very alterable by light, more soluble than those of bichromate of strychnine. They are birefracting prisms, terminating in obtuse angles.

Basic Chromate of Codeine.—In my first attempt to obtain this combination I readily succeeded, by dissolving codeine in water containing a few drops of very weak sulphuric acid, adding some solution of neutral chromate of potash. On making a second and third attempt, I was surprised to find the solutions turn brown after the decomposition of the codeine. At first I supposed I had used too much acid in saturating the codeine, and so formed a certain quantity of bichromate of potash, whose too energetic action altered the alkaloid. I then took care to use no more than was absolutely necessary for the saturation. Succeeding no better under these circumstances, I saturated the codeine imperfectly, proceeding in the following manner:—

I took 2 parts of codeine, and suspended them in 300 parts of water, and, while heating the mixture, poured therein a few drops of diluted sulphuric acid, so as to saturate the alkaloid, to which, when dissolved and saturated, I added a third part of codeine, which is soluble in 80 parts of cold water. I had then, by using 300 parts of water, sufficient liquid to prevent the deposition of the codeine on cooling. When the temperature of the solution had descended to 60°, I mixed with it 15 parts of solution of neutral chromate of potash, and in a few hours a large quantity of light yellow, needle like crystals were deposited, which, when washed and dried, were perfectly pure. A further small quantity of this chromate can be collected by evaporating the mother waters, taking care not to go beyond 60°.

Basic chromate of codeine resembles basic chromate of quinine, so as to be mistaken for it. It is more soluble. Like codeine, it is unalterable by light, and begins to decompose at about 80°.

I have tried to effect the combination of morphine and chromic acid, but all my numerous attempts were unsuccessful. Under the influence of chromic acid and chromates of potash, morphine rapidly decomposes. This alkaloid seems then to be transformed into the product named, by Marchand, morphetine.

I was equally unfortunate with narcotine, atropine, and veratrine, probably because of their feeble powers of saturation.

By epitomising the principal facts contained in this memoir, we find—

That a certain number of vegetable alkalies are capable of combining with chromic acid, either directly or by double decomposition, and of forming salts in well-defined proportions.

That the stability of the elements of alkaloid chromates is greater in proportion to the amount of base they contain.

That the most remarkable phenomenon presented by some of them is the bipartition and elimination of one of the two equivalents of base in presence of neutral chromate of potash.

Finally, that the number of alkaloid chromates, hitherto only three, has been raised to nine by the addition of chromates of quinine, quinidine, brucine, and codeine.

Are alkaloid chromates likely to be included among therapeutic agents? Clinical experiments can alone decide. Perhaps the little solubility of some of these compounds, and those the most stable, may constitute an objection, and, on the other hand, the ready alterability of others under the influence of sun and light.—*Journal de Pharmacie et de Chimie.*

INTERNATIONAL EXHIBITION.

CLASS I.

Mining, Quarrying, Metallurgy, and Mineral Products.

(*Continued from page* 178.)

THE iron and steel of India made by the natives have been celebrated for ages, and the East India Iron Company appear to be doing their best to equal the reputation of the native productions. Their specimens are well worthy of notice. Besides the ore—a rich hæmatite—they exhibit bar and pig iron, which appears equal to any produced in this country. Their steel also, both that made direct from ore in a native furnace, and that produced direct by the Bessemer process, looks of the very best kind, while the manufactured articles shown equal in finish anything of the kind produced in Sheffield. There are other exhibitors of iron manufactures—a native prince among them—who deserve notice. Nor is India deficient in other useful metals. The Government exhibits tin ores, and the metal, rich galena and lead, and antimony ore. Less useful minerals, but very beautiful specimens of the kind, are the red and yellow sulphurets of arsenic, which are said to abound about Rangoon.

Plumbago is plentiful in India, and very fine specimens are exhibited by the Rajah of Vizugapatam and others. It would take up too much space to notice all the useful minerals which are to be found in India; but we may mention the corundrum, and emery, and the sulphur, as useful to us here. Some of the minerals

appear to be worked up in India now, for specimens of sulphate of magnesia, sulphate of iron, carbonate of lead, and calomel, are exhibited; but neither apparently in a finished condition.

With the exception of coal, Canada appears to possess all the minerals which man requires for useful purposes. The collection displayed by the geological surveyors of Canada is one of the most remarkable in the Exhibition, and the Descriptive Catalogue is a most useful and complete guide to the geology of the colony. We believe the latter is now out of print; but the Commissioners should make a re-issue at once, and the entire collection of the surveyors ought to be deposited in one of our museums. A permanent colonial museum should be an established institution in London, and would form a very useful and attractive exhibition. We have now the means of making a very complete collection of colonial products, and we would suggest that steps should be taken at once to secure such an one for a national object. Thousands of emigrants who annually leave our ports for the colonies with but dim ideas of the productions of the country they have chosen for their future home, would consult it with interest; and many who may be at a loss to know in what to invest their capital or labour, might, perhaps, be helped to a decision by an examination of its contents.

The iron ores of Canada are of a remarkable character. The deposits of bog ore are of great extent, running in patches along the north side of the St. Lawrence for more than 100 miles, and, being the ore most easily dug, is almost the only one worked. When washed free from adhering earthy matters, this ore yields 50 per cent. of iron. Red hæmatite abounds in many places, but the most abundant ore is the magnetic oxide. This is found in enormous beds, varying from 10 to 500 feet in thickness, which yield from 60 to 70 per cent. of iron. Not much of this is worked at present. Ilmenite with rutile, is found in a bed 90 feet thick, which is traceable for a mile. Some galena is found and worked in the colony, but it does not appear to be widely disseminated. The yellow sulphuret of copper is shown in large masses, and one or two masses of the variegated sulphuret are exhibited. Both of these are abundant in Canada. The large masses of native copper, however, will attract more attention. One of these is a rough sheet weighing 450 lbs. This was found in a fissure, about 6 inches wide, in a band of greenstone, which was discovered to be nearly filled with native copper. The sulphuret and a silicate of nickel are present in Canada. Native silver is found sometimes associated with the native copper, and sometimes with the sulphurets of copper and iron. Gold is found in the drift of the St. Lawrence and other rivers, and also associated with other metals, as in our Welsh mines; and, "among the drift-gold of the Chaudière, there are met with, in very small quantities, grains of platinum and iridosmine, the latter being an alloy of iridium and osmium. Some of the gold met with on the Chaudière has been found thinly coated with mercurial amalgam; but no trace of cinnabar, the commonest form of the ores of mercury, has been observed in the drift." Another curious fact is recorded:—"Among the substances met with by the Canada Gold Mining Company in separating the gold from the drift, lead shot of various sizes, from partridge to swan shot, were nearly as abundant as the gold." The minerals applicable to chemical manufactures include chrome iron ore, which is abundant in Canada, and of which considerable masses are shown, molybdenite, in nodules and flakes, cobaltiferous pyrites, very poor in cobalt, dolomite, and magnesite. Petroleum is exhibited among the mineral products of Canada, but we need not say anything of that here. A bituminous shale, yielding a large quantity of oils, and masses of apatite, of which there appears to be immense deposits, must conclude our enumeration of the objects contained in this interesting and valuable collection.

Our limited space, and the necessity of noticing other departments, compel us to pass rapidly over the remainder of our colonial mineral riches. The collections of copper minerals in the South Australian Court must not, however, be passed without particular notice. The cases of Drs. Maura and Engelhardt, and Mr. Rolleson, contain specimens of great beauty. The present Exhibition contains no such objects as the malachite doors and vases in the Exhibition of 1851, but there are in the cases above-mentioned pieces of malachite of unrivalled beauty, and in the general collection masses of great size. It seems strange that the mineral has not been more generally applied to decorative purposes now that it is so abundant. Copper is the only mineral of importance in South Australia; but Victoria, besides its vast wealth in gold, has iron almost everywhere, tin in abundance, antimony, lead, and copper, the antimony occurring in thick seams with gold and quartz. Those of our readers who remember the difficulties encountered by the Mint in the attempt to coin some Australian gold which was alloyed with antimony, and the difficulty confessed, at the discussion on Mr. Warrington's paper at the Chemical Society, of accounting for the presence of this latter metal, may see it here explained. Silver is also found in Victoria; and specimens of embolite, a chloride and bromide of silver, are shown in the collection. As general collections of minerals of this colony, those of Professor Abel and Mr. Foord deserve commendation. New South Wales exhibits tin, iron, lead, copper, and silver minerals, but the collection is in confusion, and no one can see exactly what there is in it. Queensland shows copper and iron ores. Tasmania exhibits hæmatite, and some earthy minerals, with specimens of topaz and beryl of great beauty and clearness. The New Zealand collection, of course, contains Taranaki iron sand. Fine red hæmatite and chrome iron ore are also shown. There is, too, a beautiful collection of chromium salts and colours, not manufactured in the colony, we suppose. Fine native sulphur, abundant in the volcanic districts of the island, is also exhibited. From Jamaica we have iron, copper, zinc, lead, cobalt, and manganese ores; from Nova Scotia, iron, copper, and manganese; from Newfoundland, fine horn silver, quartz rich in silver, some beautiful peacock and other copper ores, and galena rich in silver. Natal sends antimony, iron, and lead; and from Ceylon we have some pure plumbago and iron; and here we must conclude our hurried account of the mineral contents of our Colonial possessions.

PROCEEDINGS OF SOCIETIES.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

(*Continued from page* 190.)

On Friday evening there was a large attendance in the Guildhall to hear an animated and interesting discourse by Professor Tyndall on the "*Forms and Actions of Water.*" The lecture was illustrated by some brilliant experiments. The Professor dwelt at the outset on the energy of molecular forces. In the combination of oxygen and hydrogen to form a gallon of water, weighing 10 lb., an energy was

expended—the atoms clashed together with a force—equal to that of a ton weight let fall from a height of 23,757 feet. In falling from the state of vapour to that of water an energy was exerted equal to that of a ton falling from a height of 3700 feet, or of 1 cwt. from a height of 74,000 feet. The moving force of the stone avalanches of the Alps was but as that of snow-flakes compared with the energy involved in the formation of a cloud. In passing finally from the liquid to the solid state, the atoms of 10 lb. of water exercised an energy equal to that of a ton weight falling down a precipice 550 feet high. The Lecturer then halted to consider some of the phenomena connected with water in its vaporous state. Its action upon radiant heat was extraordinary. Though forming only about 0·5 per cent. of the entire atmosphere, for every ray of terrestrial heat struck down by the air, fifty, sixty, or seventy rays were destroyed by the aqueous vapour. The vapour of the lecture-room was shown by condensing it on the surface of a vessel containing a freezing mixture, on which it precipitated itself in such quantity that, when scraped off, a snowball was formed of the condensed vapour. Aqueous vapour was the "barb" of our atmosphere; it permitted the solar rays to reach the earth, but intercepted the terrestrial rays in their escape towards space. The Desert of Sahara showed us what would be the effect of its removal. There, where the "soil is fire and the wind is flame" during the day, the nights are intensely cold; ice, in fact, has been known to be formed. Were the aqueous vapours removed from the air which covers England, no doubt a single summer night would destroy all plants incapable of bearing a freezing temperature. The Professor then dwelt briefly on the liquid state of water, and passed on to consider its solid form. Ice was chosen, and shown to be eminently brittle. Pieces of it when placed together froze together. This freezing was shown to occur in hot water. The ice was scraped to fine powder, and the frozen powder, placed in a mould, was squeezed to a sphere of hard ice by the pressure. Cups were formed from the ice powder; and in the presence of such experiments it was easy to see how the snow of the Alpine mountains should compress itself to ice, and how the ice could be squeezed through the moulds formed by the valleys. From existing glaciers the Professor passed on to those of a former epoch, and showed that a diminution of the sun's heat would not account for them. They were as much a proof of heat as of cold. They were a proof of powerful condensation, but to produce the vapour for condensation an enormous expenditure of heat was necessary. To produce a glacier required as much heat as would raise five times the weight of that glacier of cast-iron to its melting-point. What was wanted, then, to produce a glacial epoch was not a less powerful sun, but a more powerful condenser; and the speaker conceived that this was most easily obtained by assigning to the Alps a greater mean elevation thaa they now enjoy. For ages they have been planed down by glaciers and by atmospheric denudation generally. The valley of the Po is overstrewn with their ruins; by the wear and tear of time they must have been lowered, and hence rendered incompetent to condense the vapours necessary to produce the glaciers of a bygone age.

The following is a complete list of the Papers read in the Chemical Section on the subsequent days. We refrain from giving abstracts of them, as, through the kindness of the authors, we hope to be able to publish the most important of them in full:—

Thursday, October 2.

An Address was delivered by the President.

T. Moffatt, M.D., F.G.S.—*On the Luminosity of Phosphorus.*

Thomas Sutton, B.A.—*Description of a rapid dry Collodion Process.*

E. J. Lowe, F.R.A.S.—*Remarks on Ozone.*

J. H. Gladstone, Ph. D., F.R.S.—*On the Essential Oil of Bay and other Aromatic Oils.*

Dr. T. L. Phipson—*On the existence of Aniline in certain Fungi, which bec me blue in contact with the Air.*

Dr. T. L. Phipson—*On the Artificial Formation of Populine, and on a new class of Organic Compounds.*

Dr. T. L. Phipson—*Analysis of the Diluvial Soil of Brabant, &c., known as the Limon de la Hesbaye.*

Friday, October 3.

G. B. Buckton, F.R.S.—*Notes on the Decomposition of the Organo-Metallic Radicles.*

J. P. Gassiot, F.R.S.—*On the Mode of Preparing Carbonic Acid Vacua.*

William Odling, M.B., F.R.S.—*On the Synthesis of some Hydro-Carbons.*

Monsieur A. Des Cloizeaux—*Modification temporaire et permanente apportée par la chaleur à certaines pr priétés optiques du feldspath orthose, de la cymophane et de la Brookite.*

W. H. Harris—*On the Adulteration of Linseed Cake with Nut Cake.*

Saturday, October 4.

J. W. Osborne.—*On a Photolithographic Process adopted by the Government of Victoria for the publication of Maps.*

G. C. Foster. F.C.S.—*On the Principles upon which Atomic Weights should be determined.*

W. Odling, M.B., F.R.S.—*On the Nomenclature of Organic Compounds.*

G. Harley, M.D.—*On Schöbein's Antozone.*

D. Campbell, F.C.S.—*On the Action of Nitric Acid upon Pyrophosphate of Magnesia.*

Monday, October 6.

Dr. B. H. Paul—*On the Manufacture of Hydro-carbon Oils, Paraffin, &c., from Peat.*

A. Vernon Harcourt, M.A., F.C.S.—*On a Particular Case of induced Chemical Action.*

T. Sterry Hunt, M.A., F.R.S.—*On some Principles to be considered in Mineralogical Classification.*

Professor H. E. Roscoe—*On Hypobromous Acid.*

J. W. Osborne, Esq.—*On the Essential Oils and Resins from the indigenous Vegetation of Victoria.*

Tuesday, October 7.

J. B. Laws, F.R.S., F.C.S., and J. H. Gilbert, F.R.S., F.C.S.—*On the Effects of different Manures on the Mixed Herbage of Grass Land.*

I. Maxwell Lyte, M.A., F.C.S.—*On some of the Difficulties arising in the Practice of Photography, and the Means of removing them.*

Charles Heisch, F.C.S.—*On a simple Method of taking Stereomicrophotographs.*

William Odling, M.B., F.R.S.—*On Ferrous Acid.*

J. H. Gladstone, Ph.D., F.R.S.—*On the means of observing the Lines of the Solar Spectrum due to the terrestrial atmosphere.*

Dr. B. H. Paul—*On the Decay and Fermentation of Stone employed in building.*

Professor N. S. Maskelyne—*On Aërolites from India.*

Professor N. S. Maskelyne—*On Comlumbite from Monte Video.*

Preparing Glue for Ready Use.—To any quantity of glue use common whisky instead of water. Put both together in a bottle, cork it tight, and set it for three or four days, when it will be fit for use without the application of heat. Glue thus prepared will keep for years, and is at all times fit for use, except in very cold weather, when it should be set in warm water before using. To obviate the difficulty of the stopper getting tight by the glue drying in the mouth of the vessel, use a tin vessel, with the cover fitting tight on the outside to prevent the escape of the spirit by evaporisation. A strong solution of isinglass made in the same manner is an excellent cement for leather.

NOTICES OF BOOKS.

Report from the Select Committee of the House of Lords on Injury from Noxious Vapours; together with the Proceedings of the Committee, Minutes of Evidence, and Appendix. Session, 1862.

THE Lords are business-like men. On Friday, May 9 last, Lord Derby moved "That a Select Committee be appointed to inquire into the injury resulting from noxious vapours evolved in certain manufacturing processes, and into the state of the law relating thereto." On Monday, the 12th, the Committee was named; on the 16th they began to examine witnesses; and on July 18th they agreed on this Report, which was issued to the public about a month ago. We might contrast this promptitude with the proceedings of the Commons' Committee on the sewage question; but shall let that pass for the present, as we shall have occasion to go through the evidence taken by the latter when it is published.

The principal suggestions of the Lords' Committee we have already laid before our readers (page 156), and need only say that they meet with our entire approbation. But we would add a few words as to the qualifications of the inspectors of works, who may have to be appointed under the Act, which will probably be founded on this Report. The Committee very properly recommend that these should be entirely free from local influence, by whomsoever they may be appointed and paid. To obtain this desired freedom it is quite clear that they must not be nominated by local boards; and it would be well that they should be appointed directly by the Home Office. Beyond this it is certain that they should be well-qualified chemists. It is with no disrespect to the Medical Officers of Health that we say, that in a large majority of cases their chemical acquirements do not qualify them to deal with such matters as would be brought under their notice, if their duties involved the inspection of chemical works. The inspectors of these would require a special knowledge of the science, and a general acquaintance with manufacturing processes,—such a knowledge as in general is only possessed by one who devotes himself to chemistry alone. With this suggestion we may pass to the consideration of the evidence which was taken by the committee, some of which is of a remarkable character. The first part relates to the condition of the country around St. Helen's. Forty or fifty years ago this district seems to have been a sort of Paradise. It was distinguished for orchards and gardens, and apples were as plentiful as in Eden. But one tall chimney after another arose; copper works and silver-refining works were added to alkali works; and now the country is described as "one scene of desolation—you might look round for a mile, and not see a tree with any foliage on whatever." The acid vapours have done it all. As these drift around, trees lose their leaves; the tops decay; the bark hardens and becomes adherent; and, after a struggle for life, which lasts a year or two, the trees perish. Apples have nearly disappeared from the neighbourhood. Where twenty bushels used to be gathered, only a measure or two can be got now. Hedges have fared but little better. The sturdy hawthorn makes an attempt to look gay every spring; but its leaves, as they come out, dry up like tea-leaves, and soon drop off. The farmer may sow if he pleases, but he will only reap a crop of straw. The ears will have nothing in them. Grass grows, but it soon turns brown, and, for all the good it is, it might as well not grow. Cattle will not fatten on it; and, worse still, it makes sheep throw their lambs. Cows, too, in some situations, more exposed to the vapours, get a cough, and cast their calves; and the human animals suffer from smarting eyes, disagreeable sensations in the throat, an irritating cough, and difficulty of breathing.

As if in sympathy with this desolation in the country, the town wears a sombre aspect. Everything exposed to the vapours becomes of a "slaty-blue" colour. Aware of this, the shopkeepers paint their shutters at once the hue they would gradually become if done a brighter shade. One witness has seen a vehicle for the carriage of passengers in the country of a slaty-blue colour on one side, and a dingy yellow on the other, simply because it has been exposed to the vapour during the night. Stone, as well as paint, becomes discoloured, but does not appear to be decomposed.

Swansea has suffered as much as St. Helen's. The immediate district, which is subjected to the direct and concentrated influence of the copper smoke, is entirely denuded of vegetation; the hill-sides have not a blade of grass upon them. Here sulphurous acid and arsenic are the noxious vapours. The effects of arsenic only extend a few hundred yards, but within this area poisons everything. Grass grows, but kills the animals that eat it; and, instead of having their appearance improved, as common belief would have expected, ponies fed on arsenical grass acquire a peculiar shaggy and starved appearance, their knees swell, they get lame and hide-bound, their hair falls off, and their teeth fall out, and necrosis supervenes. No wonder that the farmers give up grazing on such tracts of land! The influence of the sulphurous acid vapours extend for miles, and is seen principally upon vegetation. It burns up the leaves, checks the natural growth, and stunts a plant. One witness showed specimens of plants which presented the appearance of having been exposed to a sirocco. This witness, a medical gentleman, who had been Officer of Health for the Borough of Swansea, has some peculiar views on the nature of sulphurous acid which we may quote. Lord Ravensworth asked, how far the influence of the sulphurous acid would extend? "That," said the witness, "is a moot point. It has been said that it will extend to a distance of twenty miles, but we have no evidence to prove that; it may extend to a large number of miles. The extent of its influence depends upon this: if the atmosphere be perfectly dry, and if the smoke be emitted at a considerable elevation, it is carried in a layer that can be traced for miles in the atmosphere; but the instant it comes into contact with moisture it is converted into vitriol; and if there be anything that is at all moist on the ground, this sulphuric acid has such an affinity for water that it drops upon vegetation, and utterly corrodes it; a fog will convert sulphurous into sulphuric acid." Rather puzzled we expect, Lord Ravensworth further asks to have the distinction between sulphurous and sulphuric acid described, and the witness gives him the following information:—"Sulphur combines with oxygen in three varying proportions; in hyposulphurous acid there is one equivalent of sulphur to one of oxygen; in sulphurous acid there is one equivalent of sulphur to two of oxygen; and in sulphuric acid there is one equivalent of sulphur to three of oxygen. Sulphurous acid will not exist where there is any moisture in the atmosphere; you could not keep it in a bottle in your laboratory, unless the atmosphere be perfectly dry; therefore, the moment any moisture exists in the atmosphere, for which it has a great attraction, it is converted into something more deleterious than itself; that is to say, it is converted into sulphuric acid." After this Lord Derby asks in what proportion water absorbs sulphurous acid, and the witness informs him accurately enough, thirty-one times its volume. Our readers will see at once that Mr. Michael is partly in the right. That the mischief is done by sulphuric acid there is little doubt; but the oxidation of sulphurous acid is a slower process than he imagines.

We may point out one other peculiarity brought out in evidence. The non-scientific witnesses from about St. Helen's state that the vapours from the alkali works are of a blue, bluish, or bluish-white colour, or bluish-grey from the copper works.

NOTICES OF PATENTS.

2037. *Tanning.* A. F. Menard, Rue de Strasbourg, Paris. A communication. Dated August 15, 1861.

This invention refers to a novel and more expeditious method of tanning leather, and is carried out by modifying, in a variety of ways, the system usually adopted. The bark, instead of being powdered, is used in bundles; an apparatus is employed wherein the pressure of the atmosphere may be alternately removed and exerted, and an adaptation allows of the injection of carbonic acid gas, which is mainly useful in preventing the conversion of tannin into gallic acid by the oxygen of the air; the employment of a voltaic current to hasten the process is also claimed, and the use of certain mineral solutions, particularly those of iron, alumina, lime, and magnesia, which are said to form chemical compounds with the tanning materials. The last claim in the specification relates to the saponification of the fatty matters in the finished leather by treatment with bisulphide of carbon, which has the property of rendering the skins more supple and pliable, and to some extent waterproof.

The use of bisulphate of carbon for these purposes has been made the subject of several patent claims (*vide* Nos. 1489 and 1566*) wherein it is recommeded to be employed either alone or in conjunction with gutta-percha and India-rubber.

2058. *Preparation, Application, and Manufacture of Peat.* W. H. Smith, Philadelphia, United States. Dated August 19, 1861.

The patentee reduces peat to an uniform pulp by trituration under the softening influence of steam, and mixes therewith certain earthy minerals or pigments for the purpose of communicating the desired colour and compactness to the mass, and rendering it suitable for a variety of ornamental applications by moulding or otherwise. By the continued action of heat the peat is said to become hardened or "vulcanised."

2059. *Soap.* W. Gossage, Widnes Dock, Lancashire. Dated August 19, 1861.

For the manufacture of those kinds of soap in which the boiling is effected by the introduction of steam, the patentee claims, firstly, the use of the steam generated during the concentration of caustic alkaline liquors, or soap lyes, in close boilers placed contiguous. Secondly, the construction of apparatus to be used in the manufacture of this same class of soaps, which apparatus provides for the steam employed being purified by passing through a bed of filtering materials, thereby causing the separation of particles of water therefrom, previously to its being used for such manufacture.

2067. *Preserving Meat, &c.* R. A. Brooman, Fleet Street, London. A communication. Dated August 20, 1861.

This invention has reference to a former patent, No. 1742, dated July 18, 1860, and consists in preserving meat and other animal substances by means of a coating of gluten, prepared as described in the specification of the patent above referred to.

2085. *Distillation.* A. Stein, Edinburgh. Dated August 21, 1861. (Not proceeded with).

The object of this invention is principally to improve the quality of the spirits, whether "grain" or "malt," produced by the apparatus already in use under the name of "Coffey and Stein's Patent Stills." Secondly, to render the "spent wash" which is discharged from these stills more suitable for the feeding of live stock, to which purpose it is now chiefly applied. It is proposed to carry out these improvements by passing the whole or greater portion of the alcoholic liquor direct into the rectifier, wherein it is to be worked off by fresh steam, no part being allowed to return or become mixed with the wash in the distilling column; and for the preparation of spirit of the highest quality, it is proposed to add to the apparatus a third or additional rectifying column.

2103. *The Manufacture of Paper.* T. Richardson, Newcastle-upon-Tyne, and R. Irvine, Hurlet, Renfrewshire, N.B. Dated August 22, 1861.

This invention consists in employing, in the manufacture of paper, aluminous products obtained by the action of sulphuric acid upon pit or alum shale, either in a roasted or natural condition, or upon the ashes of bituminous minerals, which consist chiefly of silicate of alumina, such products being used in substitution of the alum or aluminous cake (sulphate of alumina) hitherto employed, and which are extracted, at a considerable cost, from the before-mentioned compounds.

The substitution here proposed is one which would effect a considerable saving, and appears to be the next step in advance of the recommendation which led to the employment of sulphate of alumina instead of the crystallised and more expensive alum.

Notices to Proceed.

2101. James Dickson, Tollington Road, Holloway, London, "Improvements in treating copper ores and solutions of copper to obtain copper therefrom."—Petition recorded July 24, 1862.

2253. James Dickson, Tollington Road, Holloway, London, "Improvements in treating zinc ores and solutions of zinc to obtain zinc therefrom."

2426. William Hunt, Tipton, Staffordshire, "An improvement or improvements in the manufacture of muriate of ammonia."

CORRESPONDENCE.

Ceruleum.

To the Editor of the Chemical News.

Sir,—Your correspondent, H. L. L., will no doubt obtain ceruleum at Messrs. Winsor and Newton's, 38, Rathbone Place, Oxford Street, or of any other artist colourman, the colour being common enough in the trade.—I am, &c.

On the Organo-Metallic Radicals.

To the Editor of the Chemical News.

Sir,—Allow me to call your attention to your notice of my paper, "On the Organo-metallic Radicals," read at the last Cambridge meeting of the British Association. Those chemists who were present I feel sure will agree with me in the assertion, that Dr. Odling merely differed in opinion as to the best theoretical mode of grouping the formulæ of certain arsenical compounds. He did not "object to some parts of the tabulated results as inaccurate."

You will oblige me by correcting this misapprehension, originally made by the reporter of a Cambridge newspaper. —I am, &c.

G. B. Buckton.

Royal Institution, October 13, 1862.

Logwood Test for Alum in Bread.

To the Editor of the Chemical News.

Sir,—I have just had the Number of the Chemical News for September 20 put into my hands, which I find contains an article, by Mr. Hadow, of King's College, on the value of logwood as a test in detecting the presence of alum in bread, which, on reading, conveys the impression that it has been only very recently discovered. Will you, therefore, allow me to state, that I have been in the habit of employing that test in such cases for the last two years, having been recommended to adopt it by my friend, Mr. Robbins, of 372, Oxford Street, who informed me, at the same time, that he had used it for some time previous with invariable success?—I am, &c.

B. M. Johnson, Pharmaceutical Chemist.

70, Tottenham Court Road.

[There is nothing new in the test, although Mr. Hadow is the first, we believe, to publish it. It has long been in use in the Laboratory at Woolwich, and Dr. Letheby has shown it in his Lectures for years. The exact value of the test, however, has yet to be determined.—Ed. C. N.]

Balloon Ascents.

To the Editor of the Chemical News.

Sir,—As the subject of "balloon navigation" has lately attracted considerable attention, may I be permitted to offer one or two hints with the view of showing how ascents may be made to heights even greater than those reached by Messrs. Glaisher and Coxwell, without any risk beyond that unavoidably attendant upon aërial excursions of an ordinary character?

The principal obstacles in the path of the aëronaut when endeavouring to reach high altitudes are the extremely low temperature, and the highly-attenuated state of the atmosphere. Now, in order to obviate these difficulties, a chamber is constructed, large enough to hold one or two persons, and fixed in the centre of the car. This chamber should be made of thin sheet-iron (or some other suitable material), and provided with a closely-fitting door, and small glass windows. It should likewise be perfectly air-tight, and capable of resisting an internal pressure, not exceeding fifteen pounds to the square inch. The chamber is also provided with a condensing syringe, by which air from the external atmosphere can be constantly pumped in, so that the aëronaut could always inhale air equally dense with that existing at the level of the sea. The products of respiration are suffered to escape by means of a valve fitted to the roof of the chamber. The valve of the balloon itself may be opened or shut by a metallic rod, passing through a stuffing box. Lastly, the chamber may be coated with some non-conducting substance, so as to preserve the interior at an agreeable temperature. The aëronaut could with his feet work the condensing syringe, and thus supply himself with air of any required degree of compression, and, at the same time, have both his hands at liberty to register the state of the barometer and other instruments placed outside the chamber, and easily visible through its glass windows.

Another object which has been proposed, viz., to raise or lower a balloon without losing much gas, may be accomplished by having a vessel in the car, into which a portion of the gas may at any time be compressed by suitable apparatus. This would cause the balloon to descend, but on allowing the compressed gas to resume its original place the balloon would return to its former elevation.

In order to prevent accidents arising from any damage to the silk envelope, my brother (Mr. William Newlands) suggests that balloons, like ships, should be constructed in compartments.—I am, &c.

John A. R. Newlands, F.C.S.

19, West Square, Southwark.

MISCELLANEOUS.

Monument to Sir Humphrey Davy.—A monument is about to be erected to the memory of Sir Humphrey Davy, on the north side of Mount's Bay, near Penzance, where he was born.

British Weights and Measures.—Omitting many specific anomalies, we have no less than ten different systems of weights and measures, most of them established by law:—1. Grain, computed decimally, used for scientific purposes; 2. Troy weight, under 5 Geo. 4, c. 74, and 18 & 19 Vict., c. 72; 3. Troy ounce, with decimal multiples and divisions, called bullion weights, under 16 & 17 Vict., c. 29; 4. Bankers' weights, to weigh 10, 20, 30, 50, 100, and 200 sovereigns; 5. Apothecaries' weight; 6. Diamond weights and pearl weights, including carats; 7. Avoirdupois weight, under 5 Geo. 4, c. 74, and 18 & 19 Vict., c. 72; 8. Weights for hay and straw; 9. Wool weight, using as factors, 2, 3, 7, 13, and their multiples; 10. Coal weights, decimal, under 1 & 2 Will. 4, c. 76, and 8 & 9 Vict., c. 101, Nos. 1, ·5, ·2, ·1, ·05, ·025. We have also, in occasional scientific use, the weights of the metric system. For measures of length, we have the ordinary inch, foot, and yard. We have, in cloth measure, yards, nails, and ells. There are four different sorts of ells. For nautical purposes, we have fathoms, knots, leagues, and geographical miles differing from the common mile. The fathom of a man-of-war is 6 feet; of a merchant vessel, 5½ feet; of a fishing-smack, 5 feet. We have also the Scotch and Irish mile, and the Scotch and Irish acre. There are several sorts of acres in the United Kingdom, and there are a great variety of roods. We have, in almost every trade, measures of length especially used in those trades: for the measurement of horses, we have the hand; shoemakers use sizes; and we are compelled to adopt gauges where the French use the *millimètre*. These gauges are entirely arbitrary. The custom of the trade is the only thing which would decide the question, in case of dispute. For measures of capacity, we have twenty different bushels; we can scarcely tell what the hogshead means: for ale, it is 54 gallons; for wine, 63. Pipes of wine vary in many ways; each sort of wine seems to claim the privilege of a different sort of pipe. For measures of weight, we have about ten different stones: a stone of wool at Darlington is 18 lb; a stone of flax at Downpatrick is 24 lb.; a stone of flax at Belfast is only 16¾ lb.; but it is also at Belfast 24½ lb., having in one place two values. The hundredweight may mean 100 lb., 112 lb., or 120 lb. If you buy an ounce or pound of anything, you must inquire if it belongs to Dutch, troy, or avoirdupois weight.—*Report of the Select Committee.*

ANSWERS TO CORRESPONDENTS.

A Reader.—Nitrate of nickel, or the following will answer:—Sulphate of copper, 4 oz.; bichromate of potash, half a drachm. Dissolve in 4 oz. hot water; add 4 oz. sulphuric acid, and dilute with 2 gallons of water. For a red:—Sulphuric acid and dragon's blood, or a solution of iodine and iodide of potassium, 1 drachm of each to 2 gallons of water. Blue:—Ammoniacal sulphate of copper. Yellow:—Bichromate of potash, 2 drachms; and sulphuric acid, 4 oz.; dilute with 2 gallons of water.

A Dispenser.—The oxide of silver is, no doubt, reduced; and the sponginess is caused by the evolution of oxygen. It might, perhaps, be prevented by using very hard extracts.

W. R.—Pelouze and Fremy's would, perhaps, suit our Correspondent's purpose best; but he would probably find it deficient in the exact information he requires. Good theoretical knowledge and actual experience alone will make him a successful manufacturer.

Reader.—We do not know that the actual values of the conducting powers of the bodies named have been calculated in relation to that of silver. As a rule, soluble salts conduct better than insoluble.

T. C.—Only a little dexterity is necessary to fill the tube; and the exact length of the long arm being known, the graduation is simple.

N. J.—1. $KO, 2\bar{T}+CaO, CO_2=KO, \bar{T}+CaO, \bar{T}+CO_2$

2. $KO, \bar{T}+CaCl=CaO, \bar{T}+CaCl$.

You can also write the acid tartrate, $C_8H_5KO_{12}$, and the neutral, $C_8H_4K_2O_{12}$.

THE CHEMICAL NEWS.

VOL. VI. No. 151.—October 25, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Mistaken Detection of Alum in Bread.

THE case we reported last week has been carried a step further by the hearing of the summons taken out by the baker against the miller. The evidence of the chemist was as follows:—

"I received two samples of flour. I examined them by steeping them in water—a test commonly used, and which I considered eligible at the time. The results were wanted quickly, and I adopted a quick and satisfactory process. I soaked the flour some hours in water, and then filtered it. After having evaporated the solution to dryness, I obtained indications of alumina. I obtained a white precipitate, which at the time I believed to be alumina. The presence of sulphuric acid is not considered necessary for the proof of the presence of alum, because it may be obtained from other sources besides alum. These indications appeared sufficient; but, on reconsideration, there appeared some objections. But I had, in the meantime, sent off my statement, that I had found alumina in the flour. As soon as possible, I prepared flour from wheat myself, and subjected it to the same course of examination, but found, to my surprise, that I obtained like indications, which I have since found to be attributable to the *phosphates of lime and magnesia*. On reference to the usual authorities, I do not find this fact noticed. I have since examined another parcel of wheat in the same way, and obtained like results; and have re-examined one of the same samples of flour for Mr. —— by another process—Kuhlman's, modified by Odling and Crookes—and have found that the flour does not contain alum.

"Are the bench to understand that you were in error in the first place?

"Quite so, having overlooked the fact, that phosphates of lime and magnesia are soluble in water when flour is soaked for some hours.

"That has the effect of exonerating both miller and dealer?

"Yes; just so. I have no hesitation in believing, that in numerous cases where it has been stated that alum is in bread, such has not been the fact."

We may endorse the last opinion. When an experienced chemist, because he gets a precipitate by adding ammonia to water in which flour has been soaked, jumps to the conclusion that the precipitate is alumina, and overlooks the presence of soluble phosphates in the flour, what, we may ask, is likely to have happened when people, having no knowledge of chemistry, have experimented on the matter? We may feel well assured that, in most cases, the phosphates have been estimated as alumina.

We regret the occurrence of this case, because such mistakes tend to destroy the public faith in chemistry as an exact science. But it will have had an invaluable result if it directs the attention of chemists more particularly to the subject, and leads to a general agreement as to the best process to be adopted in investigations of the kind. Mistakes of various kinds in testing for alum in bread have been so numerous, that, unless some such course be taken, magistrates will never be persuaded to accept the analyses of chemists as anything more than scientific guess-work.

On the Argentiferous Gossan of Cornwall, by Dr. T. L. PHIPSON, F.C.S., &c.*

THIS gossan, of which I have examined a great number of samples from the "Silver Vein Mine" at Lostwithiel, differs notably in colour and general appearance as we pass from one sample to another. Most specimens, however, give a yellowish-brown powder, sometimes inclining to red or to white. Like all gossans, it is essentially composed of quartz and oxide of iron, but it is remarkable by the fact that it always contains a certain proportion of silver. Its density varies from 2·66 to 2·75, and its general composition oscillates between the two extreme results I. and II.

	I.	II.
Quartz	10	85
Water and crenate of ammonia .	10	3
Oxide of iron, &c.	80	12
	100	100

The quantity of quartz varies, then, in this gossan from 10 to 85 per cent.; but it passes here and there into compact quartz, &c.

I have found that the silver contained in this rock exists in the state of sulphide of silver, combined with sulphide of antimony, copper, and iron. The mineral which contains it is fahlerz, or grey copper, and is dispersed generally throughout the gossan, being often invisible to the naked eye. But in some specimens, where the quartz is compact, the grey copper shows itself in veins and plates, and when this is the case the quantity of silver is considerable. Regarding the percentage of metallic silver, I choose the following from a considerable number of assays executed in my laboratory during the present year:—

Metallic Silver, per cent.—

I.	II.	III.	IV.	V.	VI.
Brown gossan.	Black gossan.	Red gossan.	Yellow gossan.	Yellow gossan.	Yellow gossan.
0·038	0·010	0·015	0·055	0·065	0·040

VII.	VIII.	IX.	X.	XI.	XII.
Dark red gossan.	Yellow gossan.	Damp gossan.	Yellowish-brown gossan.	Wet gossan.	Compact quartz, with grey copper.
0·035	0·040	0·028	0·040	0·020	0·185

Copper 27·500

* Read to the British Association.

These analyses show that most frequently the Cornish gossan gives 0·04 per cent. of metallic silver, or 4 lbs. of silver for every 10,000 lbs. of gossan, which is about 14⅜ ounces to the ton; and that when it passes into compact quartz, showing veins of grey copper, there is a great increase in the proportion of silver and a considerable per-centage of copper.

On Organic Chemistry, by* WM. ODLING, *M.B., F.R.S.*

CHEMISTS have ascertained that the various tissues of plants and animals are composed of a great number of distinct chemical compounds, capable, for the most part, of being separated from one another by what may be regarded as physical processes, based, for instance, upon differences of volatility, differences of solubility in different liquids, &c. These proximate animal and vegetable principles, as they are termed, and the various bodies resulting from their natural or artificial metamorphoses, having been formed directly or indirectly through the agency of living organisms, are called organic compounds, in contradistinction to the pre-existing compounds of the mineral kingdom, and to the artificial compounds produceable from them.

As a rule, highly complex organic compounds are formed by an agglomeration of the residues of comparatively simple molecules, the constituent atoms of which residues are not intermingled promiscuously, but remain apart as separate groupings that are always ready, by an absorption of water, to regenerate the entire molecules to which they respectively pertain. Salicin, for instance, the crystalline bitter principle of willow-bark, contains in a state of combination a residue of saligenin and a residue of glucose, and by an absorption of water can break up into a complete molecule of saligenin and a complete molecule of glucose. These primary or constituent molecules are capable of being referred to certain definite positions in certain natural series or families. They either have a very simple constitution, or are associated with bodies of a very simple constitution, as members of one and the same organic series. Now, when the more complex members of such a series are treated by oxidising agents, bodies of a more and more simple composition are successively obtained. Oxidation tends to separate the constituent carbon and hydrogen atoms of a complex body, so as to form compounds with fewer and fewer atoms, and finally to produce carbonic acid and water, the identical compounds out of which the proximate principles of plants and animals were originally built up. Heretofore, this destructive or analytic phase of organic chemistry, this breaking-up of conglomerate bodies into their constituent molecules, and oxidation of the constituent molecules into carbonic acid and water, has been regarded as the only possible phase of organic chemistry that could ever be presented. "I show," said Gerhardt, some twenty years ago, "how the chemist does everything in antagonism to living nature; how he burns, destroys, works by analysis; the vital force alone works by synthesis, and reconstructs the edifice destroyed by chemical forces." But there is, in reality, another side to the shield; there is a constructive as well as a destructive, a synthetic as well as an analytic organic chemistry. Despite much that had been done by Wöhler, Kolbe, and others, the full recognition of synthetic organic chemistry which now obtains, together with the great advances therein that have recently been made, is mainly due to the labours of Berthelot, prosecuted uninterruptedly for the last ten years.

During the growth of a plant, there is a constant building up of organic compounds out of carbonic acid and water, and simultaneously a constant evaeuation of oxygen. Now, just as oxidation tends to separate the carbon and hydrogen atoms of complex molecules, so, on the other hand, does deoxidation, whether effected in the living organism or the chemical laboratory, tend to combine the separated atoms into comparatively complex molecules, the residues of which become banded together into still more complex conglomerate molecules. In broad antagonism to the doctrines held but very recently as indisputable, it is now known that the chemist, like the plant, is capable of producing from carbonic acid and water a whole host of organic bodies; and there seems no reason to question his ultimate capability of reproducing all animal and vegetable principles whatsoever. But while the living plant effects its synthesis of organic compounds out of carbonic acid and water, the chemist can effect his synthesis of the same organic compounds either out of carbonic acid and water, or out of the elementary bodies, carbon and hydrogen, upon which the living organism is unable to exert even the slightest plastic action.

In illustration of these views, the lecturer proceeded to show how acetylene might be produced, either indirectly from carbonic acid, through the intervention of formic acid and marsh gas, or directly by the combustion of intensely-heated charcoal in hydrogen, according to Berthelot's most recent experiments; how from acetylene might be obtained in succession olefiant gas, alcohol, and acetic acid; and from acetic acid acetone, propylic alcohol, butyric acid, succinic acid, malic acid, tartaric acid, &c. From some or other of the above bodies might also be obtained methylic alcohol, or wood spirit; taurine, an important constituent of bile; glycocol, or sugar of gelatine; glycerine, the sweet principle of fats; lactic acid, found in the juice of flesh; sulphocyanide of allyl, or essential oil of mustard; butyrin, the oily constituent of butter; asparagin, the crystalline principle of asparagus; and many other well-known complex organic compounds.

Referring to the diffusion of scientific knowledge which took place from year to year at the meetings of the British Association, Dr. Odling concluded by saying, that, although the domain of natural science was far too wide for the grasp of any but the most catholic intellect, still all might hope, whilst pursuing their special investigations, to be enlightened from time to time by a familiar exposition of the progress that had been made in kindred branches of study, and so be led to feel more deeply that their special subjects were not to be regarded as separate islands, but rather as intercommunicating tracts of one vast continent of knowledge.

* A Lecture delivered before the British Association.

On the Action of Nitric Acid upon Pyrophosphate of Magnesia, by* DUGALD CAMPBELL, *Analytical Chemist to the Brompton Hospital, London.*

WHEN nitric acid is added to pyrophosphate of magnesia, obtained by heating to redness the phosphate of magnesia and ammonia, and a heat, say of a sand-bath at about 320° F., applied to it for a long time, I supposed that the nitric acid would all be expelled, and the pyrophosphate of magnesia alone would remain; but such I did not find to be the case; nor did I find that, when

* Read before the British Association.

even a very much higher temperature than that stated above was employed, the nitric acid was then all expelled, but that, on the contrary, a large portion still remained; and likewise I find that, when a sufficient temperature is employed to volatilise the remaining nitric acid, pyrophosphate of magnesia is volatilised at the same time along with it, and in considerable quantity.

When the pyrophosphate is dissolved in nitric acid of the ordinary strength, and the whole exposed in an open capsule to the temperature first mentioned—namely, 320° F.—until the weight is constant, I found it invariably to have increased very much in weight, although not always to the same extent; but at higher temperatures the weights in most of my experiments appear to come close to each other. For instance, at 320° F. I found the pyrophosphate to have increased in weight, ranging from about 22 to about 30 per cent., a difference of 8 per cent.; while the same heated at 420° F. till constant, was from 19 to 21 per cent., a difference of 2 per cent.; and the same heated to 550° F. till constant, the increase was from 13·5 to 14·5 per cent., a difference of only 1 per cent.

When the pyrophosphate of magnesia, still retaining nitric acid, but constant in weight at 320° F., is heated to a very high temperature, which is necessary for the expulsion of all the nitric acid, and the pyrophosphate remaining weighed, it is found to have decreased considerably in weight. But the loss is not by any means the same in every experiment; on the contrary, it varies much. I have found it range from 9 to 15 per cent., depending much upon the mode of applying the heat, whether slowly or quickly. If in the latter way, the loss is greater.

When heat is applied in the same manner to the pyrophosphate of magnesia with nitric acid, constant at 420° F., and the pyrophosphate remaining is weighed, it will be found to have decreased considerably in weight, but not so much as in the last experiment; and if heat be applied to the pyrophosphate of magnesia, and nitric acid constant at 550° F., a considerable loss takes place, but again not so much as in the last experiment.

When the pyrophosphate of magnesia, with the nitric acid constant at 550° F., is heated up to the boiling-point of mercury, very little nitric acid is driven off, and at a considerably higher temperature even much of the nitric acid remains. At a red heat nitric acid is still retained, and the last traces are expelled only by a very bright red, almost a white heat.

From these experiments, I was led to conclude that nitric acid has a greater affinity for magnesia than phosphoric acid has, and that, on adding nitric acid to pyrophosphate of magnesia, nitrate of magnesia is first formed and pyrophosphoric acid is liberated; and this is easily proved to be the case by dissolving the pyrophosphate in ordinary nitric acid, and evaporating the liquid gently until of a syrupy consistency; when it is placed under a bell jar, in preference over sulphuric acid, the nitrate crystallises, although an extremely deliquescent salt, and the pyrophosphoric acid may be drained from it.

But, although nitrate of magnesia is formed, and pyrophosphoric acid is set free on the first addition of nitric acid to the pyrophosphate, I am somewhat inclined to think that, when this mixture is evaporated and treated as I have before described, the products are not always simply mixtures of nitrate of magnesia and pyrophosphoric acid, but are sometimes compounds of the two. My reasons for saying so are from observing how little deliquescent generally these products are, and how much less easily is the nitric acid expelled from some of them than from nitrate of magnesia alone. Again, the fact, that on heating these products, more especially when heating them suddenly, pyrophosphate of magnesia, not under ordinary circumstances a volatilisable salt, is volatilised along with the nitric acid. This is a strong indication that some volatilisable compound is formed which is decomposed in volatilising.

In conclusion, I would add that the most common mode of estimating phosphoric acid, and almost the sole mode of estimating magnesia, is to obtain them as the phosphate of magnesia and ammonia, afterwards calcining this salt, and from the weight of the pyrophosphate of magnesia calculating either the phosphoric acid or the magnesia, whichever may be required. Now, it is well known to chemists who have worked on this subject, that pyrophosphate of magnesia is one of the most difficult salts to calcine to a white state, and before weighing it it should be so; but to do this by simple heat is rather a tedious process; and to add a few drops of nitric acid to the pyrophosphate, and evaporate, and afterwards calcine strongly, and perhaps repeat this a second time, is a plan often recommended and followed, instead of the tedious process of long calcining; but after the details of my experiments, I need scarcely say that, by treating the pyrophosphate in this way, you render yourself liable to considerable errors either in the estimation of phosphoric acid or magnesia; and I have no doubt that this mode of operating with the pyrophosphate has been one of the causes, of which I believe there are several others besides not yet pointed out, which have led to the many disputes as to the richness of substances in phosphates. It was when engaged in some investigations of this kind, some considerable time ago, that I first observed the peculiar actions of heat at different temperatures upon pyrophosphate of magnesia and nitric acid, which I have now, in as short a manner as possible, endeavoured to lay before the members of this Section of the British Association.

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by Frank H. Storer *and* Charles W. Eliot.*

(*Continued from page* 184.)

3. Chromate of Manganese.—The existence of this chromate has been so clearly demonstrated by previous observers, that we have thought it unnecessary to add any experiments of our own. On mixing a solution of sulphate of the protoxide of manganese with a solution of chromate of potash, a chocolate-coloured precipitate subsides after some time, to which Warington† assigned the formula $(MnO)_2\,CrO_3\,2\,HO$. Bensch‡ also analysed a similar precipitate, for which he gives the same formula. In Warington's analysis the amount of protoxide of manganese is larger than the compound which his formula represents would contain, and it is, moreover, questionable if the protoxide of manganese could exist in contact with chromic acid. The subsequent observations of Fairrie§ explain these difficulties. He mixed the solutions of chloride of manganese and chromate of potash, and so obtained a precipitate whose composition by analysis was—

$$3\,(Mn_2O_3CrO_3) + Cr_2O_3 + 6\,HO.$$

* Read before the American Academy of Arts and Sciences.

† *Phil. Mag.*, [3.] xxi. 380 (1842)

‡ *Pogg. Ann.*, lv. 98 (1842).

§ *Jour. Chem. Soc.*, iv. 300 (1852

Fairrie's criticism on the analyses of Warington and Bensch, that they overlooked the chromic oxide formed by the reaction, is no doubt just. He also remarks, that the precipitate appeared to be formed by the action of seven equivalents of chromate of potash on six equivalents of chloride of manganese, but offers no explanation of the reaction. The decomposition is explained by the formula,—

$$7\,(KOCrO_3) + 6\,(MnCl) = 3\,Mn_2O_3\,CrO_3) + Cr_2O_3 + 6\,(KCl) + KO\,2\,CrO_3.$$

Six equivalents of the protoxide of manganese are oxidised into three equivalents of sesquioxide of manganese, at the expense of the three atoms of oxygen which two equivalents of chromic acid give up in changing into one equivalent of chromic oxide: probably the chromic oxide so formed enters into combination with the chromate of manganese, rendering it basic. Chloride of potassium and bichromate of potash remain in the filtrate.‖

III. The Black Oxide of Manganese ($3\,MnO_2 = Mn_2O_3MnO_3$).

Another question now suggests itself,—Would analogy lead us to suppose that there was an oxide of chromium containing two atoms of oxygen? Comparing chromium, as before, with the allied metals, aluminum, iron, and manganese, we meet with no such oxide of aluminum; and we have Fremy's¶ direct statement that he could find no oxide of the formula FeO_2. Manganese, however, forms a compound with oxygen, stable, insoluble, and natural, which has heretofore always been spoken of as an oxide of manganese, and been represented by the formula MnO_2. Is not the existence of this compound a strong argument for the oxide CrO_2? We propose to adduce the evidence which makes it most probable that this so-called peroxide of manganese is in reality a compound, sometimes definite but oftener indefinite, of manganic acid and manganic oxide, and that its normal composition is to be represented by the formula, $Mn_2O_3MnO_3$.

We shall not expect to resolve this substance into manganic oxide and manganic acid with the same facility with which we analyse the chromate of chromic oxide. This latter body is less stable than either chromic oxide or chromic acid, whereas manganic acid and oxide are both exceedingly unstable substances, obtained with difficulty, but easily destroyed. On the other hand, there is no more stable compound of manganese than that called the peroxide. It is not, therefore, decomposed, as the chromate of chromium is, by boiling water, boiling caustic potash, or a boiling solution of chloride of ammonium. We prepared artificial peroxide of manganese by passing a stream of chlorine through water in which carbonate of protoxide of manganese was diffused, and washing the precipitate, first with dilute nitric acid and then with water. The artificial protoxide thus prepared resisted solutions of chloride of sodium and of caustic potash, even when heated with these liquids in closed tubes to a temperature of 180° by means of a wax bath.

But, notwithstanding the stability of this black oxide of manganese, it is not impossible to obtain from it manganic acid under circumstances which seem to preclude the possibility of any oxidation of the substance during the process by which the manganic acid is exhibited. Mitscherlich** observed and reported the formation of the green manganate of potash, when caustic potash is fused in a retort with peroxide of manganese without access of air. Upon such authority this statement must have great weight, although the omission of the details of the experiments renders it impossible to form any opinion of the sufficiency of the evidence upon which it rests. Fortunately, the results of Mitscherlich find full confirmation in the recent experiments of Bekétoff.†† This observer has shown that, when a mixture of caustic potash and black oxide of manganese is heated, in a closed tube filled with oxygen, to a temperature of 180°, an abundance of the green manganate of potash is formed without the slightest absorption of oxygen. Unless these experimental results can be disproved, it seems impossible to escape the conclusion, that the substance called peroxide of manganese contains manganic acid, since it yields manganic acid while the ratio of its manganese to its oxygen remains unchanged.

In 1817 Chevillot and Edwards‡‡ published an account of some experiments, in which they endeavoured to prove that the presence of air or oxygen was absolutely necessary to the formation of chameleon from caustic potash and black oxide of manganese. To demonstrate this, they first heated the mixture of these two substances in a silver crucible, within a glass vessel which was filled with nitrogen, and found that no manganate of potash was produced. The amount of heat applied is not stated, but the nature of the apparatus indicates that a high temperature was used. Secondly, they heated the same mixture of caustic potash and black oxide of manganese in an atmosphere of oxygen, and measured the considerable quantity of oxygen absorbed during the formation of the manganate. These experiments seem at first sight absolutely to contradict those of Mitscherlich and Bekétoff; but it is easy to show that they have no such tendency, and that the conclusions which Chevillot and Edwards drew from them were entirely erroneous, though the experiments themselves were perfectly correct and faithfully reported. It is obvious that an absorption of oxygen is just as necessary in order to convert the substance, whose formula would be written $Mn_2O_3MnO_3$, completely into manganic acid, as it is for the entire conversion of the so-called oxide MnO_2 into the same acid. The same amount of oxygen must be absorbed in changing one gramme of the black oxide of manganese into manganic acid, however the rational formula of that substance may be written. To prove that oxygen is absorbed during the formation of manganate of potash from caustic potash and black oxide of manganese is, therefore, not at all to the purpose; the only question is,—Can any manganate be formed without absorption of oxygen? This question the experiments of Mitscherlich and Bekétoff answer in the affirmative. But if manganate of potash is formed from caustic potash and black oxide of manganese, without any addition of oxygen,

‖ We do not wish to leave the subject of the metallic chromates without noticing the remarable analyses published by Malaguti and Sarzeau (*Ann. de Ch. et de Phys.*, [3.] ix. 431, 1843) of the chromates of copper, zinc, cadmium, and nickel. The figures of these analyses correspond exactly with the following singular formulæ:—

$(CuO)_4CrO_3 + 5\,HO$, $(CdO)_5(CrO_3)_2 + 8\,HO$,
$(ZnO)_4CrO_3 + 5\,HO$, $(NiO)_4CrO_3 + 6\,HO$.

All these precipitates were washed with boiling water till no colour came from them, and it is clear that these chromates, like those which we have studied, may be deprived of the greater part of their chromic acid, if not the whole, by prolonged washing; hence the basic character of the substances analysed. The marvel is, that the analyses corresponded so exactly with such peculiar formulæ; it is hardly conceivable that the publication of many analyses of each of these substances should not show the existence of a series of compounds, which conform to no definite formulæ.

¶ *Ann. de Ch. et de Phys.*, [3.] xii. 381.

** *Abhandlungen der Akademie der Wiss. zu Berlin*, 1831, p. 218. *Ann. de Ch. et de Phys.*, [2.] xlix. 114. *Pogg. Ann.*, xxv. 287.

†† *Bulletin de Soc. Chim. de Paris*, Séance 13 Mai, 1859, i. 43.

‡‡ *Ann. de Ch. et de Phys.*, [2.] iv. 290.

how is the fact of its non-formation in an atmosphere of nitrogen, as proved by Chevillot and Edwards, to be accounted for? We have repeated the experiments of Chevillot and Edwards with a somewhat different apparatus. A combustion-tube of small diameter was nearly filled with copper turnings, and beyond the copper a platinum boat containing a mixture of caustic potash and peroxide of manganese was inserted. The tube was then connected with an aspirator, and a slow current of air was drawn through the hot copper. When time enough had elapsed to secure the complete filling of the tube with nitrogen, the platinum boat was heated gradually up to dull redness without producing a trace of the green manganate. When the tube had cooled, the contents of the boat was a fused, brownish mass. Another experiment, however, showed conclusively that the non-appearance of the green manganese is accounted for by the fact, that this manganate cannot exist in an atmosphere of nitrogen at such a temperature. We prepared some manganate of potash in a platinum boat by fusing a mixture of carbonate of potash and black oxide of manganese in the air, and then heated this boat with its contents in an atmosphere of nitrogen by means of the apparatus just described. At a temperature very much below a red heat, every trace of the green manganate disappeared, and when the tube was cool the appearance of the contents of the boat was that of a fused, brownish mass, precisely like that described above in the former experiment. Repetitions of the experiments fully confirmed these results, which perhaps ought to have been anticipated, since it seems more than probable that nitrogen would be oxidised in contact with a hot manganate. Similar experiments with an atmosphere of carbonic acid led to the same negative results. It must be borne in mind that our present purpose is merely to show the fallacy of the inferences which Chevillot and Edwards drew from their experiments, which were made at an uncertain but high temperature. We by no means wish to assert that it is impossible to obtain the green manganate of potash from a mixture of caustic potash and black oxide of manganese in an atmosphere of nitrogen, if the temperature be sufficiently low. On the contrary, we have made several experiments which tend to the conclusion that this is perfectly possible under certain conditions. A mixture of caustic potash and natural black oxide of manganese was placed in a glass tube, which was then filled with nitrogen and sealed. Thus hermetically closed, the tube was heated in a wax-bath to 180° for three hours; at the end of the experiment we found that portions of the mass in the tube had been changed into green manganate of potash, though the greater part seemed to be unaltered. Again, a mixture of potash and the black oxide, artificially prepared, was gently heated in a combustion-tube in a current of nitrogen to a temperature barely high enough to fuse the mass, and the manganate of potash was formed, small in amount, but perfectly unmistakable. In repeating this last experiment, however, we failed quite as often as we succeeded, for it is difficult to heat the mixture hot enough to insure the formation of the manganate without also heating it hot enough to destroy it. Moreover, no experiments, intended to exhibit the formation of manganate of potash in nitrogen from potash and the black oxide, can be conclusive, so long as the experimenter is unable to answer any one who may please to allege that the nitrogen used contained a trace of oxygen. Unless some method of preparing the nitrogen is used which will enable the chemist to assert that the gas is free from oxygen and from all other impurities which might affect the reaction, such experiments will establish nothing. The only conclusive method of testing the question, whether manganate of potash can be formed from the black oxide and potash alone, is that so well applied by Bekétoff, who proved that the manganate can be produced from these materials in an atmosphere of oxygen at a low temperature, without the slightest absorption of that gas. His experiments were obviously performed with such care that we have thought it superfluous to repeat them.

(To be continued.)

TECHNICAL CHEMISTRY.

On Improvements in the Manufacture of Peat Fuel, by* C. Hodgson, *Esq.*

(*Concluded from page* 163.)

Many have made beautiful and compact specimens of peat fuel, have produced charcoal from it, have made moulded ornamental articles with it, and converted the spongy mass into a fine lubricating oil, clear white paraffin, and gas of high illuminating power, but how many have fulfilled the one common-place little condition of "making it pay?" As has been before stated, the one obstacle to the fulfilment of this little condition is water, and this paper would never have been written were it not that there has lately been developed and put into operation a method of preparatory desiccation which, leaving five-sixths of the water behind in the bog actually *in situ*, enables the operator to obtain with much rapidity a substance or raw material for future operations, consisting of very nearly equal parts of peat and water, instead of laboriously cutting and moving 9 or 10 tons of dead weight to obtain the material for one ton of real fuel. The discovery of this new process, coupled with progressive improvements in compressing machinery, have brought the author's hitherto experimental work at Derrylea, near Monasterevan, to a point of efficiency which leaves no further doubt as to the possibility of producing a dry peat fuel with reasonable profit, and at such a scale as, when generally adopted, cannot fail to prove of benefit to the country at large.

Before proceeding to describe in detail the process now in operation, we will trace some of the different methods which have heretofore been tried for the drying and consolidation of peat. To attempt a history of them all would be unnecessary and wearisome, and present a retrospect not by any means encouraging. In many parts of Ireland, where even turf fuel is scarce, the peasantry make for themselves an article called "hand turf," which is formed by working the wet substance into a pulpy mass with the feet and hands, and afterwards cutting it into squares as it lies like paste on the ground. These, when they obtain a certain consistency, are repeatedly turned over and piled in heaps, and when tolerably hard are stacked for winter. This mode produces a fuel rather more dense and compact than common turf, but it is exceedingly costly, and no large quantity could be made. In Holland and Holstein, where fuel is very dear, and the peat bogs are often found totally submerged, a process somewhat similar is carried on; the peat is scraped up with perforated scoops, which allow the water partially to drain off. Having been spread on a flat piece of ground, it is then trodden out by oxen or men, and afterwards moulded as we should common bricks. These are placed to dry on hard sloping ground

* A paper read before the Institution of Civil Engineers of Ireland.

or wooden trays, and afterwards piled, but this operation will only pay where fuel is exceedingly scarce and the climate tolerably dry. An improvement on both these methods is now being attempted in Ireland. The wet peat is passed through a kind of conical cullender, made of perforated zinc or other metal. This accomplishes the mashing process very completely, and strains off any sticks or rough particles, leaving the fuel, when afterwards dried, of a very fine and close texture. An ordinary brick machine forms the strained mass into blocks, which it is proposed to dry by exposure to the atmosphere or by artificial means, but the manufacture is not yet carried on on an extensive scale. Specimens, however, which have been carefully dried seem very compact, and peculiarly adapted for making peat charcoal or coke of a more than ordinary tenacity.

The three foregoing methods have equally the disadvantage of dealing with, and frequently handling, 8, 9, or 10 tons of substance for the production of one ton of fuel, and of occupying either immense time and space for air drying, or burning a large, perhaps ruinously large, quantity of fuel to attain an artificial desiccation. Indeed, so varied have been the attempts to dry peat altogether by artificial means that its impossibility may be taken as an axiom. Containing, as usually cut with the slane, about eight or nine parts water to one of peat, it is difficult to conceive how artificial heat or currents of air sufficient to evaporate eight or nine tons of water could possibly be obtained by the combustion of one ton of peat fuel without even expecting any portion of the ton to be saved for sale. Such evaporative duty as one to eight or nine is considered very good when the best coals are burnt in the furnaces of well-constructed boilers; and although a closed boiler is probably not the best instrument for evaporating a large quantity of water economically, yet the fact, that in peat the water is intimately mixed with an extremely non-conducting substance, renders it probable that in this condition it is even more difficult to effect evaporation than in a closed boiler, where the water is left free to the action of the natural currents produced by heat. While experiencing the difficulty of obtaining a large supply of dry common peat, the Irish Peat Company erected two very large drying houses, similar to those used on the Continent for wood (which, however, when cut, is nearly as dry as air-dried peat). These houses were 150 feet long, 20 feet wide, and 10 feet high, and cost a very large sum of money. They were filled with furnaces and long flues, and very ingenious arrangements were made to ensure constant currents of air, at one time even a fan blast being used. They were maintained at a temperature of from 100° to 120°, and the peat, cut in ordinary sods, was introduced in lattice waggons, which allowed the air free access; but after protracted trials, and the consumption of much more fuel than could possibly be dried, the attempt with wet peat was abandoned, and others made with partially dry peat; but in no case was even a shadow of advantage gained, and the experiment went only to show that a considerable elevation of temperature, though combined with good artificial currents, will not compensate for the disadvantage of massing large quantities of peat together, thus hindering each portion from giving forth its moisture freely to the unsaturated atmosphere. The person who first attempted to expel from peat the water by pressure was Mr. Wye Williams, who made an extended experiment with this view at Cappogue many years ago. He succeeded by hydraulic pressure in reducing wet peat to half its original weight and one-third its original volume, but the remaining water was so closely incorporated with the peat that very little time was saved in drying, and the blocks expanded a good deal during desiccation, so as not to be much more dense than common turf. This attempt was lately repeated on a very considerable scale at the Irish Peat Company's works, but with precisely similar results. The idea of drying peat in the ordinary manner, pulverising it, driving off the remaining water from the powder, and then compressing it, appears to have originated twelve or fourteen years ago, with several persons about the same time, for there are not a few defunct patents on the subject; but their authors will appear to have had the idea that the peat powder must be hot, and that the combination effected under pressure was to be prolonged by some oily development in the peat itself, due to the heated state in which it was to be fed into the mould, and perhaps a more mistaken or troublesome delusion never hampered a really valuable principle. A few blocks of this dry, hot-compressed peat were produced by hydraulic or screw pressure about this time, *i.e.*, previous to 1850; and having a high density, and burning exceedingly well in consequence of their perfect dryness, it became a question how such were to be produced in quantity, for hydraulic pressure was clearly too slow in action to be of practical use. Variations of the lever and eccentric principle were therefore tried, and by moving them very slowly some tolerably good blocks were formed, but an attempt to drive any of them at a "paying" speed generally resulted in a failure, and if not, the blocks were found to swell again and become too brittle for carriage. A machine of this kind was placed in the Dublin Exhibition in 1853, and another was set up at a bog in Kerry at about the same time, but never was brought into steady operation, probably from the same cause. It was constructed with a lever actuated by a cam, and was arrested for two or three seconds during the formation of each block. A machine was next constructed by Gwynne and Son for Mr. Hodgson, and erected in Galway in 1854, but this also was ultimately abandoned from constant failure in the different parts. All these machines suffered from two manifest defects: they were complicated with notions for filling and discharging the mould, in which the pressure was applied, besides the main motion for compression, and when driven at any speed exceeding five or six blows per minute they failed to produce the desired effect, because the continuance of the pressure became then quite too transitory. But had success attended any of these machines, had any of them produced so much as two or three tons of fuel as dense and as portable as coal, the real difficulty of the actual manufacture would only then have commenced, for no provision had yet been made to supply these machines with dry powder of peat in any paying quantity. It was soon seen that to depend on making and grinding up common peat in this country would never answer, both on account of the small supply to be obtained in any locality, and because even that supply would cost too much to leave a profit on the manufacture. A patent has lately been taken out by the author for compressing peat dry and cold in a machine consisting simply of a horizontal reciprocating ram, working into a tube or cylinder of perfectly uniform bore, very much resembling a cannon with open breech like the Armstrong gun. Into this tube the peat powder falls as the ram draws back at each stroke, and very shortly filling the whole length, a considerable friction begins to take place against the sides of the tube. This soon increases to such an extent that as each charge falls in, it is consolidated

perfectly between the advancing ram and the column of peat in the tube before the frictional resistance of this column is overcome, and the whole mass moves on. Thus simultaneously a block is formed at the breech end, and one made perhaps a minute before it drops out at the further extremity. This machine combines the advantages of requiring no feed and delivery motion, of retaining each block fast in the tube, which is about five feet long, for more than a minute, while at the same time it delivers them at the rate of 60 per minute, making for one tube about 15 cwt. per hour. It is now at work at Derrylea, and is certainly the first machine which has in the United Kingdom produced several hundred tons of peat fuel of a density equal to coal. To supply this machine with dry material now became the grand difficulty, but here a fortunate discovery removed almost all difficulty at one stroke. The author discovered during last year that, by harrowing over the surface of the bogs with a very light harrow, a powdered peat four times as dry as the general mass would be obtainable cheaply and in any desired quantity. Operating only on the upper stratum of the bog, and removing a thin layer by two or three successive harrowings and scrapings each day, the great bulk of the water is never encountered at all, but sinks gradually away day by day to the drainage. This operation may be carried on at any season of the year, on every day not actually raining, but of course it proceeds more advantageously in summer, when large stores of the powder or mull are collected and heaped in embankments, which are found not to re-absorb water. The average proportion of water is about 55 per cent., and the material when collected costs about 5d. per ton. A few hours are allowed to intervene between harrowing and scraping, so that the air may assist in drying out the thin stratum exposed to it. The complete desiccation of this powder is easily effected by passing it over extensive plates of iron heated by the waste steam from the compressing engine, and it is then fit for being compressed. By this mode, peat standing in this primitive bog in the morning is harrowed and scraped, brought in, dried on the steam surface, compressed, and before night falls as a complete and excellent fuel in the canal boat, which conveys it to market.

PHARMACY, TOXICOLOGY, &c.

New Tests (?) for Phosphorus in Cases of Poisoning.

In the Chemical News for September 27th we gave a report, by Mr. Hoffman, a Jamaica chemist, relative to a case of alleged poisoning by phosphorus. We have now received the following observations on this report:—

Sir,—Having read Mr. Hoffman's report on his analysis of Mr. Foster's remains, I am somewhat surprised to find he arrives at the conclusion that death was caused by a poisonous dose of phosphorus. There is nothing I can gather from the results Mr. Hoffman says he obtained in his investigation that justifies this conclusion. That gentleman had at his disposal the methods of Lipowitz and Mitscherlich for the detection of phosphorus. I will not pretend to say these processes in some instances may not fail to detect minute traces of this poison, but I believe when they do fail us we have no better ones at present to rely on. Mr Hoffman, however, tells us he has lately enriched the science of chemistry with two new tests for the detection of this substance, which are infallible. I shall presently give my grounds for doubting whether one of them is infallible—of the existence of the other I have not yet been able to convince myself. From Mr. Hoffman's silence on the subject we must infer, either that he did not employ the methods of Mitscherlich or Lipowitz in his analysis of Mr. Foster's remains, or that, if he did, they gave him negative results: he bases his conclusion that phosphorus had been taken on the following grounds:—

1st. That the stomach, according to his observation, bore marks of corrosion.

2nd. That the contents possessed an acid reaction.

3rd. That a rather large quantity of (free ?) phosphoric acid was present in the viscera.

4th. That certain microscopic crystals, said to be phosphate of ammonia, were found on paper that had been kept for three weeks within the mouth of a jar containing the putrefying remains.

5th. On the ground that a certain reaction was obtained with perchloride of iron; the viscera having been previously subjected to a particular process. This reaction occurring under the circumstances named by Mr. Hoffman, he says, clearly indicates the presence of phosphorus: it is one of his new tests for the detection of this poison.

The first three grounds I shall exclude altogether from the discussion, since, viewed in lights most favourable to Mr. Hoffman's hypothesis, they would only render it rather probable the poison phosphorus had been taken. But Mr. Hoffman does not deal in probabilities; if he did I should treat these grounds very differently. He distinctly says free phosphorus was in the viscera he analysed; he proved its presence clearly by means of his crystal and colour tests. (See two last grounds, also the report.) I shall, therefore, at once go into the proof—alleged to be perfect in itself—afforded, or said to have been afforded, by means of these reactions.

Firstly, then, as regards the crystals found on paper kept for three weeks within the mouth of a jar containing the putrefying remains: did Mr. Hoffman clearly prove by the application of proper tests that they were crystals of phosphate of ammonia? Form alone, I maintain, would have been no sure criterion—if he did, he does not say so in his report. However, admitting they were proved satisfactorily to be phosphate of ammonia, which, I believe, is giving him a great advantage in the argument, it then becomes a question—would the production of a small quantity of this salt, under the circumstances, warrant the conclusion, that free phosphorus had been present in the viscera? I contend that, in what I believe to be the present state of our knowledge, it would not.

It has been stated, on very good authority, that gases composed of phosphorus and hydrogen are evolved by animal matter in a state of putrefaction; these, and ammonia rising in the jar containing the remains, meet with atmospheric air; we have thus, in a confined space, a gaseous compound, containing all the elements to produce phosphate of ammonia. From the known affinities of the bodies, it is probable they would combine to produce this salt. Has Mr. Hoffman or any other chemist proved, by extensive and very carefully-conducted experiments, that a small quantity of the salt in question never is produced under the circumstances? I think not; yet, until I am convinced this has been done, I shall refuse to consider the discovery, supposing it was made, of a trifling quantity of phosphate of ammonia on the paper placed over Mr. Foster's remains, as clear proof that they contained free phosphorus. The following experiments were undertaken to ascertain if I could produce the reaction with phosphorus and perchloride of iron, described by Mr. Hoffman; also to test in some measure the delicacy of Mitscherlich's test for the detection of the poison:—

1st. 3 drachms of phosphoric paste (equal to about 2½ grains of phosphorus) were given to a cat at 4 p.m.; the animal vomited soon after, apparently nearly the whole dose came up. The creature was found dead the next morning. The stomach was removed and placed in a jar for analysis. The large and small intestines were placed in another jar. The analysis was made the same day—

decomposition had already commenced. The analysis of the stomach, by Mitscherlich's method, gave negative results; not a trace of free phosphorus could be detected in that organ; but on submitting the large and small intestines to the same process, the well-known light soon made its appearance in the condensing tube, and remained visible for about half an hour. The process was then discontinued.

2nd. A mixture composed of 1 grain of phosphorus and 3 ounces of putrid meat was submitted to the above process. With this large quantity of phosphorus the light was very bright, and at the conclusion of the operation—continued for half-an-hour, several globules were found in the receiver; that these were phosphorus was proved by their luminous appearance in the dark, and by their igniting spontaneously when placed in a warm situation.

3rd. 5 ounces of soap and a quarter of a grain of phosphorus were treated as above; a distinct light was obtained, which remained visible for an hour. The process was then put a stop to.

4th. A mixture composed of one-fiftieth of a grain of phosphorus, 8 ounces of putrid meat, and 11 ounces of water, acidulated with sulphuric acid, was submitted to the same operation as above. In this instance also, phosphorescent light soon made its appearance in the tube, and continued visible over an hour; thus proving that, in some instances at least, a small quantity of phosphorus may be detected, by this method, in a large mass of putrefying animal matter. All the above experiments were commenced in broad daylight, and in each case a portion of the distillate was submitted as soon as obtained to Mr. Hoffman's test: in no instance was the phenomenon described by that gentleman observed. Nevertheless—and although from the first I could not understand how phosphorus could produce it—my mind was anything but satisfied; for when a scientific man tells me in plain terms he has produced a very remarkable phenomenon over and over again by certain simple means, I am bound to have some respect for his statement, and to doubt for a considerable time the correctness of negative results, obtained, under apparently the same conditions, by any other person. I have, therefore, laboured to obtain this colour much more than I should probably have done had the idea that phosphorus could produce it originated with myself. I have brought the substances said to be concerned in its production together under every variety of physical condition I can think of, but as yet have not been fortunate enough to see it. Until I do see it, I must refuse to consider Mr. Hoffman has demonstrated in any way that Mr. Edward Foster died from the effects of a poisonous dose of phosphorus.—I am, &c. David Lindo.

Note.—Since writing the above I observe Mr. Hoffman lays particular stress on the circumstance that the viscera reached him in a state of good preservation. His words imply, this was additional proof that free phosphoric acid was present, since, acccording to his belief, this acid retards putrefaction. I extract the following from Wagner's Memoir (see *Annual Report of Chemistry*, Vol. 1. pp. 360 and 361): "Small quantities of strong mineral acids prevent fermentation, with the exception, however, of phosphoric acid, which appears to favour it." Fermentation and putrefaction are analogous processes, as every chemist knows. D. L.

On a Spurious Glycerine,
by Harry Napier Draper, *F.C.S.*

I have recently had occasion to examine an article which, under the name of "German Glycerine," has found its way into commerce, and, I have reason to believe, to a considerable extent. Apart from the importance of exposing a fraud which is at once the most ingenious and the most shameless which has ever come under my observation, it presents one or two points of interest.

This so-called "glycerine" is a semi-fluid mass, so viscid as to be with difficulty poured from one vessel to another, colourless, and perfectly, almost brilliantly, transparent. It is absolutely free from smell, and its taste is less sweet than that of pure glycerine as represented by the preparation of Price's Candle Company. It has a density of 1·436. (The specific gravity of anhydrous glycerine is 1·270; of Price's, 1·240.) This high density was of itself sufficient to show that this substance could not be pure glycerine, and it was further examined, with the following results:—

Evaporated at a temperature sufficient to cause ebullition, it gave off watery vapour, and, on cooling, solidified into a transparent brittle mass.

At a higher temperature this solid fused, became coloured, and was finally converted into a shining black substance, easily recognisable as caramel.

Boiled with solution of potash, it gave a brown liquid.

Heated with a few drops of solution of sulphate of copper and excess of potash, an immediate and abundant precipitate of suboxide of copper was produced.

Largely diluted with water, and placed in contact with yeast at a temperature of 60° F., active fermentation rapidly set in, alcohol and carbonic acid being produced.

These results placed beyond doubt that the "glycerine" consisted, if not wholly, at least in great part, of a concentrated solution of glucose, but it still remained to be decided whether *any* glycerine was present. Now, while I am, for my own part, satisfied that it does not contain glycerine, it is by no means easy to demonstrate the entire absence of this body.

That, however, glucose forms by far the greater part of the syrup, is shown by its becoming solid on evaporation, by the transformation of apparently the whole of this solid into caramel, and by the fact that, when the glucose had by fermentation been converted into alcohol, glycerine could not be detected in the evaporated residue. Pure glycerine, largely diluted with water, and left in contact with yeast for the same time, and under like circumstances of temperature, &c., underwent no change. It was necessary to make this experiment, as glycerine is, at a somewhat higher temperature, converted by yeast into propionic acid.

An attempt to detect the presence of glycerine, by taking advantage of its ready solubility in absolute alcohol, was unsuccessful, as the residue from the evaporation of the alcohol proved to be uncrystallisable grape sugar.

I had hoped that the absence of the characteristic odour of acrolein, when the mass resulting from the evaporation of the syrup was heated with anhydrous phosphoric acid, would have been a conclusive proof of the absence of glycerine; but it was found to be practically impossible to recognise this odour in the presence of the irritating vapour evolved during the caramelisation of glucose.

My reason for thinking it probable that some glycerine was present was this:—I thought it likely that it might be used for the purpose of preventing the crystallisation of the glucose; but I am now of opinion that the syrup consists of the uncrystallisable modification of this sugar.

It would be very interesting to learn the exact process by which a solution of uncrystallisable sugar, so free from colour and so transparent, was obtained; as, from

its great density, it would doubtless prove valuable in preserving many substances which, like iodide of iron, are easily oxidised.

If it be found, on further experiment, that glycerine suffers decomposition in contact with yeast and glucose, at the lowest temperature sufficient for the fermentation of the latter, a reliable mode of detecting very small quantities of glycerine in the presence of this sugar will still be a desideratum. Since, however, the above experiments were made, it has been suggested to me by my friend, Professor Galloway, that a modification of the method of Fehling might be used for the isolation of glycerine under these circumstances.

PHYSICAL SCIENCE.

On the Means of Observing the Lines of the Solar Spectrum Due to the Terrestrial Atmosphere, by* J. H. Gladstone, *F.R.S.*

Those missing rays of the solar spectrum, usually known as Fraunhofer's lines, have lately become of great chemical interest, as they enable us to draw conclusions respecting the composition of the sun's atmosphere; but there are other lines and bands which have also a chemical interest, inasmuch as they are due to the air that surrounds our globe. These lines increase in intensity as the sun sinks towards the horizon, and some of them only make their appearance when his rays pass through a long stratum of our atmosphere: they are not always the same; they seem to be much more apparent in some localities than in others; and it is certain that they differ under different atmospheric conditions. They do not appear to arise from any of the principal constituents of the air, but are probably due to two or three gases or vapours present in minute and variable quantities.

What these gases are, experiment has yet failed to determine. They are not any of those which have been hitherto recognised as producing absorption lines in the spectrum.

The object of the present communication is to incite observers to watch these lines and bands in different places, at different altitudes, at different periods of the day, and under different conditions of clear sky, mist, cloud, heat, frost, &c. There is no difficulty about seeing them; any ordinary spectroscope will show them near sunset; and the author, in his journeying this summer, has carried about with him one of Crookes's Pocket Spectroscopes, which proved very efficient as well as portable, and with this he made observations till nightfall from the summits of the Rigi, and in several other places both abroad and in this country. There are as yet no results which he cares to publish, but he has observed several bands not recorded in the map of Sir David Brewster and himself in the *Philosophical Transactions* for 1860. This map, with its indication of the different atmospheric lines by Greek letters, must, however, serve as the reference for all observations now made. In observing the actual disc of the sun, a piece of cobalt blue glass will be found useful as a screen, since it cuts off the dazzling yellow rays, and allows the passage of the more refrangible rays of the spectrum, amongst which are situated some of the most interesting of the atmospheric lines; yet observations should always be taken without the blue glass as well. A close approximation of the edges of the slit will diminish the brilliancy of the light, while it increases the sharpness of the lines. In addition to the direct rays of the sun, those reflected from different parts of the sky should be examined; and that not merely at sunrise or sunset, when there is the maximum, but also at midday, when there is the minimum effect of the terrestrial atmosphere.

* Read before the British Association.

NOTICES OF BOOKS.

Report from the Select Committee of the House of Lords on Injury from Noxious Vapours; together with the Proceedings of the Committee, Minutes of Evidence, and Appendix. Session, 1862.

[Second Notice]

The injury ensuing to vegetation detailed in our last being proved and confessed, our readers need hardly be informed that land in the neighbourhood of alkali works is, for agricultural purposes, greatly depreciated in value. A small portion available for building purposes is increased in value, but, on the whole, there is a considerable loss. The present, then, is a landowner's inquiry; but it is pleasant to find that the soda manufacturers in general are perfectly agreed in a desire for some legislative remedy. At present, some condense the hydrochloric acid, while others do not; and difficulties often occur in deciding which of two manufacturers, one of whom condenses, while the other does not, really causes the damage. There is also a perfect unanimity of opinion as to the efficiency of the original condenser of Mr. Gossage and the several modifications of it which have since been introduced. When properly managed, that is, well supplied with water, not more than $\frac{1}{1200}$th of the gas is likely to escape, and if more than one tower is used, not even so much as this. A high chimney is simply the means of diffusing the vapour over a larger area. In its course the vapour gets largely diluted by the atmosphere, but still, when it falls, its ill effects are apparent enough. Failing to obviate the evils complained of, high chimneys have, nevertheless, proved effectual mystifiers of lawyers and farmers, inasmuch as, when there are several, it becomes impossible to trace the vapour to particular works.

Mr. Gossage's evidence, as that of both a practical and scientific man, is some of the most valuable taken by the committee. He explained very clearly that the use of the condensers interferes so little with the work as not in that respect to be worth consideration. The common excuse for inefficiency—the carelessness of workmen—he answered satisfactorily when he said that the workman's carelessness was under the control of the master. It is a misfortune that, when the vapour is condensed, there is so little demand for the liquid acid that only one-fourth of the amount produced meets with a sale. The rest is allowed to run into rivers, where its presence is objectionable; but, said Mr. Gossage, it gets there too late to destroy fish; they had been killed or driven away before.

There was one point on which Mr. Gossage was a little at issue with Drs. Hoffmann and Frankland, to which we may allude at once. It related to the detection of an escape of vapour. The Committee supposed that, in the daytime, or when the visit of an inspector might be expected, the condensation might be carried on satisfactorily enough; but how was it to be known that no escape took place at night? Dr. Hoffmann said that it was not easy, in the present state of chemical science, to say what sort of apparatus could be constructed for the purpose; he had never heard of one. Mr. Gossage, however, had already proposed what appears to us to be a very simple and effectual means of making the discovery. He suggested that a vessel containing a solution of nitrate of silver should be placed in communication with the flue which leads from the condensers to the chimney, and that air

from the flue should be drawn through the solution by means of an aspirator. We see no difficulty in this, nor in placing the apparatus under lock and key, so that it could not be tampered with.

More difficult to deal with than the acid vapour, is the alkali waste. This, consisting mainly of sulphide of calcium, lies in heaps of enormous extent around and about the various alkali works. There is but little use for it. Ingenious people have mixed it with other ingredients, and formed bricks and paving materials of it, but with small commercial success. Mr. Gossage has spent 20,000*l.* in trying experiments to recover the sulphur from it, and has not discovered any process which will pay. So there it lies, "in thousands upon thousands of tons," giving off large quantities of sulphuretted hydrogen, too perceptible to the nose, sometimes actually poisoning people, as witnessed by Dr. Playfair and Liebig, and communicating that peculiar colour to paint and stone which we have already remarked. These heaps are exposed to the air, and sometimes they take fire, the consequences of which our readers can guess. Oftener the rain falls, and dissolves out some sulphide of calcium, which drains away to the rivers, and probably percolates into the wells, in both cases a pollution and a nuisance. Can nothing be done with this? Would it cost too much to fill up worked-out coal mines with it?

Dr. Playfair divided noxious vapours into three classes. The first included hydrochloric acid gas from alkali works, nitrous acid from vitriol manufactories, and sulphuretted hydrogen from alum works. All these, he said, were injurious, and their escape could be easily prevented. The next class included sulphurous acid from copper and lead smelting. This was injurious, but at present no efficient means of condensing it was known. The third class was the organic effluvia from knackers' yards and prussiate works. These also, no doubt, are injurious to health, but no perfectly effectual means of preventing their escape has been devised. There are other vapours which are offensive to the senses, but may not be injurious, such as the stenches from bone and soap-boiling, and from starch-making, and creosote-distilling. But the alkali works, the Doctor said, constitute the monster nuisance, and that could well be made the subject of legislative interference. He recommended, however, that no particular plan of condensation should be prescribed, for that might act as a barrier to invention. Several methods were in use, no one of which possessed any great advantage over the other. Large makers of sulphuric acid, he said, could economically condense their nitrous acid, but there was a difficulty in small works. The escape of sulphuretted hydrogen, too, where alum was made from gas liquor, was easily prevented, and these two trades might also come within the compass of legislative and compulsory measures. But the copper works, he thought, must be excepted. We intimated as much when we first drew attention to this committee, and recommended manufacturers to be on their guard against being compelled to adopt useless measures; and we are now pleased to find that the scientific witnesses have not lent themselves to any visionary schemes for accomplishing impossibilities.

We can, in general, express our perfect agreement with all that fell from Dr. Playfair, but must point out what appears to us to be one inaccuracy. The third class of noxious vapours, those which were emitted from decaying animal and vegetable matters, he thought might be prevented by a very little expenditure in disinfectants, such as Macdougall's powder, and Condy's fluid; but peat charcoal, the Doctor said, was not what a chemist would call a *disinfectant*. It was a good *deodoriser*, preventing smell by burning the bad smells. We believe peat charcoal to be as complete a disinfectant as the permanganate of potash, and much more so than the mixture of carbolic acid and sulphite of lime, which, perhaps, is neither a disinfectant nor a deodoriser. In the slow combustion which takes place in the pores of the charcoal, we believe that the noxious vapour is as perfectly oxidised, and, therefore, as completely disinfected, as it would be by passing through a solution of the permanganate. Can Dr. Playfair mean that the products of the combustion of bad smells are not innoxious? If so, he is opposed to the experience of all investigators who have published their results, and ought immediately to communicate his own, for we must have been led into great error. We are inclined also to differ from the witness as to the gaseous emanations in the manufacture of creosote from coal-tar, and by the distillation of wood, but it is a matter of small importance, and we may allow it to pass.

NOTICES OF PATENTS.

2096. *The Preparation of Pulp for Paper.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated August 22, 1861.

This invention relates to improvements in the preparation of pulp for paper-making, and consists in employing for this purpose grass wrack (*Zostera marina*), the residuum of beet-root from sugar manufactories, and common hay, (preferring, for the sake of economy, such as may have become damaged by rain or damp, and which, consequently, may be obtained at a low price). These substances are first immersed for about twenty-four hours, more or less, in a lime bath, the strength of which must be varied according to circumstances, whereby they become reduced to a sort of pulp, and may be used separately or mixed, or in combination with the ordinary pulp for the manufacture of paper. For the complete removal of extraneous vegetable matters, the crude pulp is boiled with a mixture of salt and caustic soda (or its equivalent lime, salt, and soda ash) for a period of twelve hours, and under a pressure of four atmospheres, after which it is washed and treated with trinitrophenic or carbazotic acid, then bleached by chloride of lime, sulphurous acid, or any of the known bleaching processes, and finally well washed with water. The products so obtained are then in a fit state to be applied to the purpose already indicated.

The interesting discussion arising out of Mr. Henry Harben's proposal for employing *Zostera marina* as a substitute for cotton, is now occupying so large a share of public attention, that the properties of this species of *alga* are likely soon to be fully ascertained.

Whatever may be the ultimate decision respecting the applicability of this material to the manufacture of textile fabrics, there can be no doubt regarding the possibility of employing it for the preparation of a crude pulp useful in paper-making. The merit of suggesting this latter application seems, however, to rest with Monsieur Mennons, of Paris, whose patent bears date May 3, 1861.* A little later, Mr. E. Hartnall,† of Ryde, conceived the same idea, but was unable to proceed with his specification on account of M. Mennon's earlier claim. Neither is there any novelty in the selection of hay as a source of ligneous fibre or crude pulp for paper-making, since a patent was granted in November, 1860, for the same application. With regard to the chemical treatment adopted in the present instance, there is an anomaly in the use of carbazotic acid, which, in itself expensive, would but communicate a yellow tint to the pulp, and operate in a manner antagonistic to the bleaching action immediately to follow as the next step in the order of treatment.

2127. *A New and Economical Method of Producing Dynamic Electricity, thereby obtaining Useful Chemical Compounds.* F. Tolhausen, Paris. A communication. Dated August 26, 1861. (Not proceeded with).

In order to produce an energetic current of voltaic elec-

* Chemical News, Vol v p. 97. † *Ibid.*, Vol. v. p. 236.

tricity, and at the same time give rise to the formation of valuable products, the inventor proposes to use such acid and metal in the battery as will, during chemical action, evolve much heat, and produce by their combination a valuable metallic salt. The metals most appropriate for this purpose are iron, zinc, lead, copper, and silver, and the acids one of the following: hydrochloric, nitric, sulphuric, acetic, and chromic. The negative plate is either of carbon or platinum immersed in strong nitric acid, and when, during the action of the battery, nitrous fumes are evolved, they are conducted into olive oil, or oleic acid derived from this and other sources, which are thus converted into eläidine, or eläidic acid, and so become suitable for the manufacture of candles similar to those made from stearine.

This proposal is in effect similar to that upon which the "Electric Light and Colour Company" commenced its operations. Experience has shown that the extra labour necessitated in the production of chemical compounds within the battery is a formidable obstacle in the way of carrying out the principle of this invention.

2142. *Apparatus for Concentrating Ores or Tailings, or Separating Pulverised Mineral Substances of Different Kinds or Qualities from each other.* B. Browne, King William Street, London. A communication. Dated August 28, 1861.

In describing the process for separating pulverised minerals by agitating the mixed substances in a body of water, and pouring off the lighter particles whilst in a state of suspension, the patentee claims a form of apparatus particularly suitable for this operation, in which a current of air is made to traverse the liquid, and so retard the precipitation of the lighter portion, but not interfere with the subsidence of the heavier particles, which usually constitute the more valuable portion of the ore under treatment.

This apparatus would be more serviceable when employed in connection with gold-washing, and in the treatment of poor ores or tailings.

2146. *Manufacture of Sugar.* J. Duncan, Greenock. Dated August 28, 1861. (Not proceeded with.)

This proposal relates to the employment of sulphurous acid as a means of counteracting the alkalinity of sugar solutions in the process of refining. The specification also describes an improved mode of reburning the animal charcoal, by which this process becomes a continuous operation. The exhausted material is introduced at one end of an iron retort, within which a rod and scrapers (blades fixed at an angle) are kept in rotation; the effect of this arrangement will ensure thorough contact of the bone black with the heated surfaces of the retort, and the particles will be pressed forward until they fall from the retort into a closed receptacle placed beneath.

2159. *Manure.* A. Taille, Agen, France. Dated August 30, 1861.

The patentee gives the following directions for the preparation of an animal manure of great value:—He takes the refuse of tanneries, such as waste horn, hair, and wool, scrapings or parings of hides, and leather cuttings of every description; any or all of these materials are introduced into a digester, into which is passed steam from a neighbouring boiler at the pressure of three or four atmospheres, the treatment being maintained from fifteen to twenty hours, according to circumstances, by which time the matters will be completely reduced to a kind of soft pulp, or even to a liquid state. In this condition he transfers the softened material to a kneading machine, and intimately incorporates with it a quantity of finely-ground bones; the composition is then, in summer-time, merely dried by exposure to air and sun, or in winter placed upon a drying apparatus; finally, it is ground to the required degree of fineness between mill-stones.

Such a manure would give high per-centages of phosphates and nitrogen: the former would not, however, be presented in the most available form.

Grants of Provisional Protection for Six Months.

2446. William Clark, Chancery Lane, London, "Improvements in the manufacture of a blue colouring matter."—A communication from Charles Philippe Collin, Boulevart St. Martin, Paris.—Petition recorded September 4, 1862.

2535. James Webster, Birmingham, "Improvements in the manufacture of nitric and nitrous acids, and other nitrogenous compounds."—Petitions recorded September 15, 1862.

2554. George Haseltine, Fleet Street, London, "Improvements in apparatus for the manufacture of gas from petroleum oil and water, and from cannel coals, bituminous coals, schists, tar, crude coal oil, or other hydrocarbons and water."—A communication from James Edward Thomson and Henry Youle Hind, Toronto, Canada.—Petitions recorded September 17, 1862.

2565. William Glass, Princes Street, Stamford Street, Lambeth, Surrey, "Improvements in the treatment of sulphuret of antimony, and in obtaining products therefrom."

2583. James Wilson, North Brixton, Surrey, "An improved composition for preventing and removing incrustations in boilers."—Petitions recorded September 20, 1862.

2605. William Maddick, jun., Liverpool, "An improved process or method of treating and preparing madder for dyeing purposes."

2627. Charles Denton Abel, Southampton Buildings, Chancery Lane, London, "A new or improved purifying and preservative lotion for the mouth."—A communication from Johann Georg Popp, Vienna, Austria.

2633. Hiram Hutchinson, Rue Notre Dame des Victoires, Paris, "Improvements in machinery for covering wire with India-rubber and gutta-percha, and similar gums and compounds thereof, and for manufacturing tubes and other articles of such gums and compounds."—A communication from Thomas Sault, Seymour, Connecticut, U.S.—Petitions recorded September 27, 1862.

2645. Henry Ellis, Bangor, North Wales, "Improvements in the manufacture of compounds of silica to mineralise woven fabrics, paper, and paper pulp, to harden and preserve stone and cement in the production of artificial stone and paint, and in the production and glazing of porcelain and such like manufactures."

Notices to Proceed.

1608. William Blackmore, Foynes, and Henry Lamb, Ennis, Limerick, Ireland, "Improvements in burning limestone, and generating steam."—Petitions recorded May 28, 1862.

1631. Henry Potter Burt, Charlotte Row, Mansion House, London, "Improvements in protecting wooden posts from decay, more particularly applicable to posts for supporting electric telegraphic wires."

1662. Carroll Eugene Gray, Great Suffolk Street, Southwark, Surrey, "Improvements in apparatus for extracting, rendering, receiving, purifying, cooling down, and delivering oleaginous and fatty matters, or other material treated by steam pressure for extraction."

1670. Goldsworthy Gurney, Bude, Cornwall, "Improvements in apparatus for production and application of artificial light."

2044. James Dickson, Tollington Road, Holloway, London, "Improvements in the manufacture of caustic

soda and carbonate of soda."—Petition recorded July 17, 1862.

2254. James Dickson, Tollington Road, Holloway, London, "Improvements in treating ores and solutions of lead to obtain lead therefrom."—Petitions recorded August 12, 1862.

2265. James Dickson, Tollington Road, Holloway, London, "Improvements in the manufacture of chlorine for commercial purposes."—Petition recorded August 13, 1862.

1637. Alfred Gilbey, Oxford Street, London, "Improvements in the construction of packing-cases or boxes for holding bottles, either full or empty."

1723. Arthur Knowles, Birstal Dye Works, Birstal, near Leeds, Yorkshire, "Improvements in apparatus for washing extracted wool and other fibre."—Petitions recorded June 9, 1862.

1743. Balthasar Wilhelm Gerland, Newton-le-Willows, Lancashire, "Improvements in the manufacture of sulphate of copper, and in obtaining metals from the material used in such manufacture."

CORRESPONDENCE.

A Question for Chemists.

To the Editor of the CHEMICAL NEWS.

SIR,—Can any of your readers oblige me with an answer to the enclosed?

Given—a mixture of proto-nitrate of mercury, water, and iron filings, gently heated for a short time. What are the changes and results, and the equation for them?

I am, &c. * * *

Artificial Tourmalines.

To the Editor of the CHEMICAL NEWS.

SIR,—"An Amateur" will find a detailed account of the method of making artificial tourmalines, by Dr. Herapath's process, in *The Quarterly Journal of Microscopical Science*, Vol. ii., page 83, contributed by Dr. Herapath himself.

I am, &c.

C. W. Q.

Logwood Test for Alum in Bread.

To the Editor of the CHEMICAL NEWS.

SIR,—Mr. Johnson is correct in stating that there is nothing new in the use of logwood for the detection of alum in bread; for the article which contains the test is not new, having been originally a paper read before the Chemical Society in February, 1857, and printed in the Quarterly Journal for that year. At *that* time, as far as I am aware, the test was a new one.—I am, &c.

EDWARD A. HADOW.

Analysis of Soap.

To the Editor of the CHEMICAL NEWS.

SIR,—Having had occasion of late to make some analyses of what is called "domestic soap," and having followed the method pointed out by Normandy in his "Commercial Hand-book," and which is similar to other works I have seen on the subject, I have found out that I have arrived at very erroneous conclusions.

In the CHEMICAL NEWS, Vol. iii., p. 176, you give a method by Dr. Buchner: that system, for nine-tenths of our English soap, I feel certain is quite worthless.

Before troubling you with what I have found to be better methods, I should be glad if any of your readers would refer me to a standard writer, if there be one, on the subject, in order that I may see if the source of error has been previously pointed out. Many hundred tons of soap are weekly made in this country, and it is of importance that the system of analysis should be correct.

I have little doubt but what you have subscribers who are soap manufacturers and also experienced analysts, and who could, if they were to throw aside the selfishness of keeping their knowledge to themselves, give your readers much correct information on the subject.

Perhaps this letter might be the means of drawing forth what I am sure some of your readers can give; if not, then I who am only of a very short standing in the trade, will give the benefit of my experience.—I am, &c.

TECHNOLOGIST.

[We shall be glad to hear further from "Technologist" on this subject.—ED. C. N.]

LABORATORY MEMORANDA.

Sodium Amalgam is best made in the following manner:—Place a small hard glass flask with a narrow neck nearly up to the mouth on sand in a sand-bath, kept at a temperature of about 300° F. Weigh out the mercury and sodium; put the former in the flask, and then add the sodium in pieces as large as a pea at a time, waiting for the action to cease, before adding a fresh lump. The sodium had better be dropped in with a pair of tongs, and the hand should have a cloth over it. At each addition of the sodium a slight explosion will be heard, and a bright flame will issue from the mouth of the flask. The action gets less violent as the mercury becomes richer in sodium. When the whole of the sodium has been added, pour the amalgam into a flat dish whilst still liquid, and when cold break it up and preserve in a stoppered bottle. It will not require to be kept under naphtha. The amalgam forms a mass of long, needle-shaped, brilliantly-metallic crystals, which interlace in every direction, but have very little cohesion.—W. C.

ANSWERS TO CORRESPONDENTS.

E. E. H..—The dose of jalapine is from one to five grains.

K. C. F. Y.—1. You will find as good an account in Ure's "Dictionary of Arts and Manufactures" as anywhere. 2. Yes.

Teuto.—Received. We will refer to the volume, and see if the mistake suggested has been made.

A Constant Subscriber.—It was evidently a mistake on the part of the author.

A Reader.—The Friday evening Lectures only are published in abstract in the Proceedings of the Royal Institution. The other lectures have only been published in our pages.

A Constant Reader.—Monamines are bodies in which one or more atoms of hydrogen in ammonia are replaced by a radical. They are called primary, secondary, or tertiary, according as one, two, or three of the atoms of hydrogen are replaced by substitution. See "Fownes' Manual," last edition.

W. G.—There is no method yet devised which will effectually prevent carbonate or sulphate of lime from adhering to the sides of a kettle when hard water is used, without injuring the water for domestic purposes. W. G. can try the effect of keeping a few lumps of clean wood charcoal in the kettle. This will do some good, but it will not prove a perfect remedy.

Phenyle.—1. We believe the Manchester Company prepare their carbolic acid from coal-tar, and that they possess a patent for its mode of manufacture and application to sanitary purposes. A patent was granted also, some years since, to Mr. Macdougall for the use of carbolic acid in admixture with the sulphites of magnesia and lime for the purposes of a disinfectant. 2. The forthcoming Report of the Juries of the International Exhibition, Class II., Section A, will probably furnish the information you seek. 3. There would, we think, be risk in applying it, unless very much diluted, to the coats of animals, in such places as they could lick.

G. D. G.—The ordinary dryers for paint consists of the acetate of lead, but, when required to be used in conjunction with zinc white, it is advisable that no ingredient containing lead should be employed; and, in order to guard against the blackening by sulphuretted hydrogen, the sulphate of zinc is generally used as dryers. The article known in the trade as "patent dryers" consists usually of a mixture of the two salts already mentioned, with the addition of a certain quantity of sulphate of baryta; the proportions of the several ingredients varying with the quality of the article, which can be obtained at widely-different prices.

THE CHEMICAL NEWS.

VOL. VI. No. 152.—November 1, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chromate of Chromium, and Analogous Chromates, with a New View of the Constitution of the Black Oxide of Manganese, by FRANK H. STORER *and* CHARLES W. ELIOT.*

(*Concluded from page* 209.)

We have been at such pains to review and explain the experiments of Chevillot and Edwards, in order to put the decomposition of the substance called peroxide of manganeso into manganic oxide and manganic acid in its true light, as an uncontradicted fact, resting upon the highest authority. If we add to this decomposition of the black oxide of manganese by potash the other fact, that it is a perfectly neutral or indifferent body, possessing none of the properties either of an acid or of a base, we have evidence, not sufficient, perhaps, absolutely to prove that its true rational formula is $Mn_2O_3MnO_3$, but quite enough to show that the formula MnO_2 is no argument for the formula CrO_2, in the face of the demonstration of the true character of the chromate of chromium heretofore given. On the contrary, the fact, that the supposed brown oxide of chromium is in reality composed of chromic oxide and chromic acid, gives additional weight to the experimental evidence already accumulated, that the peroxide of manganese is a compound of manganic oxide and manganic acid. There is a striking similarity between the methods of preparing chromate of chromium and manganate of manganese, the more noticeable in view of the very different stabilities and solubilitics of the oxides of these two metals. Thus the action of chlorine on chromic oxide gives rise to the formation of chromate of chromium, while its action on the carbonate of manganous oxide produces the manganate of manganese.† Again, the gentle ignition of the nitrate of manganous oxide produces a mixture of manganous oxide with the higher oxides of manganese; this mixture contains so much manganate of manganese, that the process has been patented as a method of obtaining a manganese oxide adapted to the preparation of chlorine.‡ This result corresponds precisely with the result of igniting the nitrate of chromic oxide. Again, the absorption of oxygen by heated chromic oxide exposed to the air, observed by Krüger, finds its exact parallel in the absorption of oxygen by manganous oxide under the same circumstances. A mixture of the higher oxides of manganese is so obtained, and this process of ignition has been long known in the arts as a means of "revivifying" black oxide of manganese, rendering it available for the preparation of chlorine a second time, or through an indefinite series of alternate reductions and oxidations.§

While it is much easier to obtain the manganate of manganese in a state of tolerable purity than it is to prepare the chromate of chromium, because of the greater insolubility of the first substance, it would, nevertheless, be very difficult, to say the least, to precipitate it by the method of double decomposition. We can readily mix chromate of potash and a normal salt of chromic oxide, and throw down the chromate of chromic oxide: till we can prepare a pure and neutral manganate of potash, the true composition of the manganate of manganic oxide cannot be illustrated in this way.

IV. OTHER CHROMATES OF CHROMIC OXIDE.

Under the head of "Bichromate of Chromic Oxide," the English Editor of Gmelin's "Handbook of Chemistry"‖ has described two processes, neither of which has any connection with the name and formula at the head of the paragraph; the first is the description of a washed, and, therefore, basic, chromate of chromic oxide, prepared by Traube,¶ identical with the substance analysed by Rammelsberg, as Traube himself remarks, and having the same formula by Traube's analysis, viz., $(Cr_2O_3)_3(CrO_3)_2$; the second is the description of the mode of precipitating the chromate of chromic oxide, $Cr_2O_3\ CrO_3$, from chrome alum by chromate of potash, in the manner we have fully explained.

For the existence of what the translator of Gmelin's** "Handbook" calls the "Neutral Chromate of Chromic Oxide," with the formula $Cr_2O_3\ 3\ CrO_3$, there seems to be no sufficient evidence. Unverdorben, Berzelius, and Maus have proved beyond a question, what hardly required proof, that when heated above the melting-point chromic acid is ultimately resolved into oxygen and chromic oxide. Traube†† has thought to show that by using the temperature but little above 250° a definite chromate can be obtained, corresponding to the formula $Cr_2O_3\ 3\ CrO_3$. By heating a quantity of chromic acid to this required temperature, he obtained a black mass, which had taken the shape of the crucible; this he

* Read before the American Academy of Arts and Sciences.

† Gmelin's "Handbook of Chemistry," iv. 207. (Cavendish Soc. Ed.)

‡ Berthier, *Ann. de Ch. et de Phys.*, [2.] xx. 187. Gatty, Eng. Patent Specifications, 22 Aug. 1857, No. 2230, p. 3.

§ Pfaff. Schweigger's *Jour. für Ch. u. Phys.*, liii. 122 (1828).
Binks, C. Eng. Pat. Specifications, 8 Feb. 1839, No. 7963, pp. 4, 8, 9.
Ebelmen. *Ann. des Mines* [3.] xvii. 517 (1840).
Walters, G. S. Eng. Pat. Specifics. 24 Mar. 1843, No. 9676.
Balmain, W. H. ,, ,, ,, 31 Mar. 1855, No. 723, p. 4.
Dunlop. ,, ,, ,, 22 Nov. 1855, No. 2637, p. 3.
Barrow. ,, ,, ,, 26 Feb. 1856, No. 485, pp. 4, 9.
Elliot. ,, ,, ,, 13 Oct. 1856, No. 2392, p. 4.
Pattinson. ,, ,, ,, 21 Oct. 1856, No. 2475.
Gossage. ,, ,, ,, 8 Nov. 1856, No. 2630, p. 7.
Reissig. *Ann. der Ch. u. Pharm.* ciii. 27 (1857).
In several of these specifications the removal of alumina and sesquioxide of iron is described, preparatory to the roasting of the manganous salt or oxide. The more manganic acid formed by the roasting the better,—may not, then, the admixture of a certain amount of these bases be chemically advantageous? Very possibly there are mechanical advantages to be gained by their removal.

‖ "Handbook of Chemistry," iv. 115. (Cavendish Soc. Ed.)

¶ *Ann. der Ch. u. Pharm.* lxvi. 108 (1848).

** "Handbook of Chemistry," iv. 116. (Cavendish Soc. Ed.)

†† *Ann. der Ch. u. Pharm.* lxvi. 106 (1848).

powdered and digested with water, with the expectation of dissolving that portion of the chromic acid which had not been affected by the heat; the wash-water after some days still remaining yellow, he concluded that the substance itself gradually dissolved, and proved this to his own satisfaction by analysing two portions, one of which had been washed more than the other, with the same result, viz., 57·93 per cent. of chromium, and 42·07 of oxygen. These figures correspond to the formula $Cr_2O_3\ 3\ CrO_3$. Now, chromic acid contains 52·23 per cent. of chromium, and chromic oxide 68·62 per cent.; and in changing from the first into the second, under the influence of a moderate heat, the heated substance will at some moment contain 57·93 per cent. of chromium; before that moment it would contain less; after that moment, more. We were not so fortunate as to hit on the right time for stopping the experiment. We subjected a mass of chromic acid to a temperature a little above 250° for three hours, and obtained a brownish black substance, such as Traube has described, which, powdered and boiled with water, imparted a faint yellow colour to the liquid. Analysis showed that it contained 54·12 per cent. of chromium. It is quite clear that any substance prepared in such a way must be a mixture, and that the particular mixture analysed by Traube has no claim to the name and formula of a definite compound.

Still another hypothetical chromate, called "Soluble Brown Chromic Oxide, or Acid Chromate of Chromic Oxide," figures in Gmelin's "Handbook (*loc. cit.*) Maus and many others have made a solution of hydrated chromic oxide in aqueous chromic acid, but Maus alone has analysed the solution; we have already expressed our opinion that the liquid he analysed was only an indeterminate mixture (page 170). The observation and the conjecture of Berzelius, cited by Gmelin in this paragraph, we have already remarked upon; the precipitate which Berzelius speaks of is the chromate of the formula $Cr_2O_3\ CrO_3$.

To sum up the case,—there is not a particle of evidence of the existence of any chromate of chromium containing more than one equivalent of chromic acid. Such may be hereafter discovered, but it does not seem probable that they will be found to be insoluble compounds. Until the realities are made known to us, why cumber the science with names and formulæ, which fill no gaps, extend no analogies, bridge no difficulties, but are merely a perplexity and a hindrance? It has been too much the custom to call the chromate of the formula $Cr_2O_3\ CrO_3$ the basic chromate of chromium; this proceeds on the assumption, that there is some other salt better entitled to the name of normal or neutral chromate, as, for example, the imaginary chromate containing three equivalents of chromic acid. Until some such chromate is discovered, the word *basic* would be better omitted from the name of the only definitely-determined chromate of chromium.

On the Composition of a Peculiar Substance which Exudes from a Tertiary Rock in Australia, by Dr.* T. L. Phipson, *F.C.S., &c.*

In a recent number of the *Geologist* (February, 1862) appeared the description and a figure of a tertiary limestone on the river Murray, in Australia. In this limestone are remarked a series of holes or warrens, inhabited by innumerable hosts of wallabies, kangaroo-rats, &c., and from these cavities there exudes a peculiar, brown, sticky, odoriferous matter, which I have analysed. It contains:—

Bitumen and petroleum, with *débris* of mosses	40·57
Carbonate of lime	30·52
Sand and mica	22·49
Phosphate of alumina, with a little oxide of iron	6·42
	100·00

No uric acid, or any other organic matter besides those named above, is present. The *débris* of mosses amount to about 4 or 5 per cent. of the whole; under the microscope the structure of the seed-caps, leaves, &c., is distinctly seen. The bitumen belongs to the species known to mineralogists as *Maltha*. It is impregnated with petroleum, which causes it to stain paper like oil. This peculiar substance is, therefore, made up of natural hydrocarbons, which have cemented together about 60 per cent. of mineral matter. It has nothing to do with the animals above named, except that by boring into the rock they have given it a means of exit. From this we may, perhaps, predict that the discovery of petroleum oil in Australia will follow that in America, as the discovery of gold has done.

* Read before the British Association.

TECHNICAL CHEMISTRY.

On Webster's Method of Preparing Oxygen Gas from a Mixture of Nitrate of Soda and Oxide of Zinc, by John Henry Pepper, *Esq., F.C.S., A. Inst. C. E., Professor of Chemistry, and Hon. Director of the Polytechnic Institution.*

The statement, that large quantities of oxygen gas could be quickly and easily procured from a mixture of one part, by weight, of nitrate of soda, and two parts of crude oxide of zinc, obtained from the (so-called) galvanising zinc-pots or baths of Birmingham and other places, appeared so doubtful, that, prior to the introduction of the new process at the Polytechnic, I was induced to visit Mr. Webster and his co-patentee, Mr. John H. Porter, at Bent's Wharf, Cannon Row, Westminster, in order to investigate practically the working of this new mode of making oxygen gas.

The apparatus, arranged for the manufacture of oxygen and other products, consists of a circular, portable, iron, fire-brick lined furnace, containing an inner strong cast-iron vessel, 10 inches in diameter, furnished with a cover and iron tube: into this is placed a second cylindrical iron pot, or retort, of 7 inches diameter, open at the top, and provided with an orifice at the base, temporarily stopped with a piece of sheet iron, so that, when the materials used are exhausted, the inner pot can be removed, and the contents easily knocked out with an iron bar; and as the product left after the disengagement of the gas is not allowed to fuse, and only becomes slightly coherent or pasty, this cylindrical form of retort, open top and bottom, and placed in an outer vessel of iron, which can be properly closed by a luted cover, answers remarkably well, and may be used by any intelligent workman. In connection with the outer iron vessel is a 1½-inch iron pipe luted into a stoneware tube, forming part of, and leading to the bottom of a 30-gallon stoneware vessel, containing half a gallon of water (5 lbs.), and eight movable stoneware, colander-like shelves; upon these are placed 48 lbs. of residue, which have been taken out of the retort after a former experiment, *i. e.*, when the oxygen has been obtained

from it. This residue, or *caput mortuum*, consisting (as will be noticed more particularly in another part of this paper) of oxide of zinc, caustic soda, nitrite and nitrate of soda, &c., is moistened with half a gallon of water, and carefully placed on the shelves, which are fitted in one after the other, commencing at the bottom of the vessel. The purifier, thus arranged, is furnished with a lid dropping into a water-joint, and the whole connected with a sheet-iron gasometer, painted inside and out, and having a sectional area of 28·2744 feet, making the cubical contents per vertical inch 2·3562 c. i.

As the success of the process, so far as the maximum of oxygen is concerned, depends greatly on the thorough dryness of the materials used, 12 lbs. of nitrate of soda were dried on a hot plate forming the top of the circular iron furnace, and 24 lbs. of oxide of zinc were made red-hot in the retort; the loss of weight by this method of drying was very slight, and did not exceed an ounce or so in either case.

Ten pounds of the dry and warm nitrate of soda, and 20 lbs. of the dry and warm oxide of zinc, were then roughly mixed together in an iron tray, and dropped through an iron funnel into the inner red-hot retort, which could be easily lifted in or out of the exterior one by means of a chain and little crane attached to the furnace.

The cover, provided with a hole at the top, was then luted on with a mixture of Stourbridge clay and sand, and in about a minute or so the nitrate of soda gave off oxygen, coloured with the orange-red fumes of nitrous acid: the top aperture was now closed, and the connection with the purifier and gasometer opened at 1·30 p.m.

The following columns show the rate at which the gas was made, although it is right to state that the gas comes over frequently much faster:—

Time.	Vertical Inches, equal to 2·3562 Cubic Feet.
1.30	
1.35	1·50
1.40	1·90
1.50	2·30
2.00	3·00
2.10	4·30
2.30	6·75
2.40	8·50
2.50	9·75
3.00	11·00
3.10	12·00
3.20	13·00
3.30	13·30
3.45	14·00
4.00	14·30

2·3562 × 14 vertical inches = 32·968 cub. feet.

Directly the gas ceased to come over, the valve in connection with the gasometer was turned off, and the inner retort, being lifted out with the contents (the residue or *caput mortuum* already mentioned), and weighed, was was found to have lost 5·5 lbs. After knocking out the residue, the retort was again quickly charged, at 4h. 5m. p.m., with a fresh mixture of 10 lbs. nitrate of soda and 20 lbs. of oxide of zinc, which gave off the whole of the gas by 6h. 30m. p.m.

The gas amounted to 14·3 vertical inches—

14·3 × 2·3562 = 33·69 cubic feet,

and the loss of weight of the materials used was again found to be 5·5 lbs. The residue in the purifier having now been used for these two charges, was taken out, and it weighed 2 lbs. heavier than before, in consequence of its having absorbed nitric acid. The residue was then digested with the whole of the weak nitric acid which had been absorbed by the half-gallon of water placed at the bottom of the purifier (the whole weight of the acid being about 11 lbs.), and when perfectly dried and warm it weighed 48 lbs. It was then placed in the retort, and lost 4 lbs., producing (according to Mr. Webster, who watched the operation to the end) 28 cubic feet of gas, —thus showing that when 50 lbs. of refuse material out of the retort are used to purify the gas from 20 lbs. of nitrate of soda, the nitric acid obtained during the process is retained, partly by the solid substance, and partly by the water in the purifier, and that, if the whole is then mixed, digested, dried, and subsequently heated in the retort, it will give out almost as much gas (28 cubic feet) as 10 lbs. of fresh nitrate of soda (33 cubic feet).

The 50 lbs. of residue were procured after heating a mixture of 20 lbs. of nitrate of soda and 40 lbs. crude oxide of zinc; so that the quantity of gas obtained by this plan from 20 lbs. of nitrate of soda, and using the nitric acid, amounts to—

	Cubic feet.
1st charge of 10 lbs. nitrate of soda and 20 lbs. crude oxide of zinc . . .	32·986
2nd ditto, ditto	33·69
3rd. Material out of purifier, after being used to absorb the nitric acid produced from Nos. 1 and 2	28 co
Total cubic feet . . .	94·676

Theoretically, and supposing the 20 lbs. of nitrate of soda were chemically pure, and decomposed into oxygen and nitrogen, leaving a residue of soda, the loss should be 12·82 lbs.; the loss was, however, 5·5 × 2 = 11 lbs. The nitrate of soda used was the ordinary commercial article, and contains 2¼ per cent. of chloride of sodium.

The gas obtained from the nitrate of soda and oxide of zinc was analysed by the phosphorus method, and also by the usual hydrogen mixture fired by the electric spark in Ure's syphon eudiometer, and gave, as the mean of several experiments, 59 volumes per cent. of oxygen gas, and 41 volumes per cent. of nitrogen.

94·676 cubic feet of gas, therefore, contain,—

	lbs.	oz.
55·858 cubic feet of oxygen* =	4	11
38·818 cubic feet of nitrogen =	2	13
Nitric acid and loss . . .	3	8
	11	0

The nitric acid appears to be formed during the first stage of the process, when the materials thrown into the red-hot retort are comparatively cold, and evolve nitrous acid, NO_3, and oxygen; these gases, in the presence of the moisture of the purifier, form nitric acid, and it is very likely, that when a second and smaller red-hot iron vessel, containing oxide of zinc, or, still better, oxide of copper, is connected with the first iron retort, any acid produced during the process would be decomposed perfectly by the second red-hot surface, and, even if nitrate of zinc or copper were formed, it would be ultimately decomposed into nitrogen, oxygen, and oxide of copper. The experiment again, twice repeated, afforded nearly the same results:

Experiments.	Nitrate of soda.	Oxide of zinc.	Loss.	Cubic feet of gas.
No. 1.	10 lbs.	20 lbs.	5·25	37
No. 2.	10 ,,	20 ,,	5·25	32
2	20 lbs.	40 lbs.	105	69

	Grains.
* Weight of a cubic foot of oxygen, at a temperature of 60°, barometer 30 inches	590·8
Weight of a cubic foot of nitrogen, at same temperature and pressure.	517·7

In order to ascertain how often the same 20 lbs. of oxide of zinc could be used with separate additions of 10 lb. charges of nitrate of soda, three experiments were tried, as tabulated below, it being understood that the second 10 lbs. was not added till the first had evolved its gas, and so on with the third 10 lbs.:

Nitrate of soda.	Oxide of zinc.	Residue.	Loss.	Gas. Cubic feet.	Nitric acid in solid contents of purifier 56 lbs.	Nitric acid absorbed by water in purifier.
10	20	25·5	4·5	49·47	2 lbs. increase in weight.	3lb.+water5 total, 8 lb. Sp. gr. 1·136
10	—	30·0	5·5	47·12		
10	—	36·25	3·75	47·12		
30	20	36·25	13·75	143·71	2 lbs.	8lb. s.g.1·136

These experiments were performed between 1 p.m. and 10 p.m., and it is evident that there is a great increase of gas, and a reduced proportion of nitric acid. It may be noticed, as a proof of the rapidity with which oxygen is prepared by this process, that, with a small apparatus only capable of containing the three charges above mentioned, it produced 143·71 cubic feet of gas (containing 59 per cent. of oxygen) in nine hours, or nearly 16 cubic feet per hour.

If the apparatus had been large enough to contain more materials, there is no doubt that the same 20 lbs. of oxide of zinc would have done with one or two more separate 10 lb. charges of nitrate of soda.

The oxide of zinc probably acts mechanically (like oxide of manganese with chlorate of potash), and also chemically, as a carrier of nitric acid. When the nitrate of soda is heated, it gives off nitric acid, which is probably taken up by the oxide of zinc, and again decomposed (as the temperature rises) into oxygen and nitrogen; and, as before stated, if a second small red-hot vessel, containing oxide of copper or zinc, was attached to the retort, the whole of the nitric acid would probably be decomposed, and an increased proportion of oxygen obtained.

In order to form some notion of the value of the gas as a means of increasing artificial light, a peculiar shaped Bude Light burner, consuming coal-gas instead of oil, was experimented with.

The burner, with oxygen admitted to the centre of the flame, consumed, according to an experimental meter made by Brown and Bischoff, 4·2 cubic feet of coal gas, and 5·3 cubic feet of the oxygen gas per hour, and produced a light equal to 36·7 Parliamentary candles, consuming 120 grains per hour.

The same quantity of coal gas per hour, burnt in a 36-hole argand burner, with a chimney 9½ inches high, gave a light equal to 10·1 candles.

The light obtained from the coal gas and oxygen was exceedingly bright and white, both gas and candle-light looking yellow by the side of it.

The cost of the coal gas alone, to produce the same light, would be about equal to that of the extra oxygen used; but the purity of the light, and the saving of gas burners and fittings, by using oxygen and coal gas, increase the value of the combined arrangement.

To ascertain the composition of the residuum, weighing 36 lb. 4 oz. (left in the retort after the three experiments, in which the same oxide of zinc was used three times), it was digested with plenty of water, and the insoluble oxide of zinc separated by a calico filter, and this, when washed and dried, weighed 23 lb. 12 oz.

The filtrate and washings, evaporated to dryness in an iron vessel, weighed 15 lb. 4 oz., and a portion of this analysed gave the following results:—

Insoluble matter, nearly all oxide of zinc	4·20
Oxide of zinc soluble in the soda	4·40
Water	15·00
Soda	37·00
Chloride of sodium	5·54
Nitrite of soda	5·15
Nitrate of soda	28·31
Loss	·40
	100·00

The 36 lbs. 4 oz. would, therefore, contain, according to this analysis (stating it in round numbers, and omitting fractions):—

	lbs.	oz.	lbs.	oz.
23 lbs. 12 oz. of oxide of zinc and alkali, less 10 oz. water				23 2
15 lbs. 4 oz. consisting of oxide of zinc	1	5		
,, soda	5	10½		
,, water	2	4		
,, chloride sodium.	0	13		
,, nitrite of soda	0	12½		
,, nitrate of soda	4	5		
Loss	0	2		
	15	4		
Less water	2	4		
	13	0	= 13	0
Loss			2	0
			36	4
13 lbs. 12 oz. gaseous matter lost by the 30 nitrate of soda, consisted of 143·71 cubic feet of gas, containing—				
83·36 cubic feet of oxygen gas.			7	0½
60·36 ,, nitrogen gas			4	7
10 lb. nitric acid, sp. gr. 1·136, containing 19·128 per cent. dry acid (Ure's table)			1	14½
Loss†			0	6
			50	0

With respect to the cost of the oxygen gas prepared by Webster's process, it may be stated that, taking the commercial price of nitrate of soda to be 14*l.* 10s. per ton, and the crude oxide of zinc at 2*l.* per ton, the value of 30 lbs. of nitrate of soda would be about 3s. 10d., and that of the 20 lbs. oxide of zinc, 4d., making a total of 4s. 2d.; and the following table exhibits the probable value of the products:—

Materials— Cost of Materials.	s.	d.	Products. Gas.	Soda.	Nitrate of Soda.	Nitric Acid.	Oxide of Zinc.
30lbs. Nt. Soda	3	10	143·71 cubic ft. containing 83·36 of oxygen	5lbs. at 2d. per lb ‡	4lbs. at 1½d. per lb ‡	10lbs. containing 2lbs. stronger, at 6d. per lb.	20lbs. at 4d.
20lbs. Ox. Zinc	0	4					
50lbs	4	2	1s. 6d.	10d.	6d.	1s. 0d.	4d.

On comparing the cost of this method with those of other sources of oxygen gas, it will be noticed that Webster's is the cheapest known process, if the products

† Probably not really a loss, but represented in the 2lbs. of nitric acid absorbed by the solid matter in purifier, which is, no doubt, of a higher quality than that absorbed by the 5 lbs. of water in the same purifier, and equal to 8lbs., sp. gr. 1·136.

‡ A chemical manufacturer would separate, by crystallisation, the greater part of the nitrite, nitrates, and chloride of sodium from the caustic soda.

can all be realised. Monsieur Deville calculates the cost of oxygen, obtained from various substances, as follows:—

		Fr.	s.	d.
One cubic metre (equal to 35·317 cubic feet):				
,,	from chlorate of potash .	10·00=8	4	
,,	,, oxide of manganese .	4·87=4	0¾	
,,	,, sulphuric acid . .	1·00=0	10	
,,	,, nitrate of soda, ox. zinc .	.	0	7 1/10
,,	,, do. rejecting all products	.	1	9 1/10

The cheapness of Webster's process is so satisfactory, that it will probably be used at the Polytechnic, provided that the nitrogen mixed with the oxygen does not materially interfere with the brilliancy of the lime-light.

Additional Report on the Above Process, by WILLIAM CROOKES.

BY the kindness of the proprietors of the patent, I have been afforded an opportunity of critically examining every stage of the above process, and am, therefore, enabled, from personal observation and experiment, to endorse all the facts given by Mr. J. H. Pepper in this report. The gas is produced from materials of but trifling value, in large quantity, and by an operation requiring no skilled superintendence whatever. At first sight it would seem that the proportion of nitrogen present with the oxygen would tend to render the gas of only slight commercial value. A little consideration will, however, show that this is not necessarily the case. Although pure oxygen is invaluable in the laboratory, and at the lecture-table, its employment in an undiluted form would be impracticable in ordinary metallurgical operations on a large scale, as the intensity of its action would very soon rise to such a degree of violence as to reduce flux, fuel, metal, and furnace into one chaotic liquid mass. It is, indeed, very doubtful whether the mixed gas which is obtained in such abundance under this patent is not as strong as could be employed in most manufacturing operations without serious damage to the furnaces and crucibles used. The only case in which it is likely a purer gas would be required is in the metallurgy of the more refractory platinum metals. The intensity of the "lime light" produced with this mixture is necessarily inferior to that obtained with pure oxygen, but it is abundantly sufficient for all ordinary purposes of illumination, and far better than could be anticipated from the composition of the gas. Indeed, it is only by comparing the two lights simultaneously, side by side, that the difference of intensity becomes apparent.

On the Manufacture of Hydrocarbon Oils, Paraffin, &c., from Peat, by* B. H. PAUL, *Ph. D., late Managing Partner in the Lews Chemical Works, Stornoway, N.B.*

THE author detailed the results which had been obtained at some works lately established under his direction in the island of Lews, one of the Hebrides.

The peat occurring in this island, like most of the peat in the Highlands of Scotland, is a remarkably rich bituminous variety of mountain peat, of a dark brown or black colour, and heavier than water, weighing sometimes as much as 78 lbs. to the cubic foot. It burns with a brilliant white flame of great length, and considerable heating power, indicating the presence of a large amount of bituminous substance.

The tar obtained from this peat by distillation was quite solid at the ordinary temperature. It had a density of 0·960, a dark brown colour, a penetrating odour of creosote, and melted on the fingers like butter.

* Read at the Cambridge meeting of the British Association.

The analysis of this tar showed that it yielded hydrocarbon oils and paraffin of good quality. Two samples gave the following per-centage results:—

Refined oils and paraffin .	42·161	41·167
Creosote	30·459	47·068
Charcoal and waste . .	27·380	11·765
	100·000	100·000

Corresponding to 111 and 107 gallons of refined oils and paraffin from the ton of tar. About one-half of the oil was of a pale yellow colour, with but a slight, not unpleasant, smell. It burnt well in the lamps commonly used for hydrocarbon oils, with a brilliant white flame. It did not carbonise the wick while burning, or resinify by exposure to the air. Its boiling point being above 300° F., there was no danger of explosive vapour being given off from it at any temperature it would be likely to be heated to in a lamp; and, as compared with some other oils of good quality, it gave, measure for measure, a greater quantity of light.

The paraffin obtained from the tar amounted to about one-tenth the weight of refined oils, and the remainder consisted of an oil of greater density and higher boiling point, also of a pale yellow colour, and having scarcely any smell. It burnt with an intense white, luminous flame, and when mixed with fat oils formed an excellent lubricator.

With regard to the possibility of carrying on the manufacture of these oils, everything depended upon the cost at which the tar could be obtained. To determine this it was requisite to ascertain the cost of the peat, the amount of tar it yielded, and the cost of production. For the purpose of obtaining some preliminary information on these points, recourse was had to the report made on this subject, in 1851, to the Chief Commissioner of Woods, by Sir Robert Kane, embodying the result of an investigation, by himself and Mr. Sullivan, of the destructive distillation of peat, which was then proposed to be undertaken on a large scale in Ireland.

The analytical results given in that report indicate a much larger per-centage of oils and paraffin to be obtainable from the tar of Irish peat than had been obtained from the tar of Lews peat; the results obtained by Mr. Sullivan varying from 38·2 to 70·2 per cent. by weight of the tar, with an average yield of 52·2 per cent., as shown in TABLE I.

—	Pounds per cubic foot.	Peat distilled in retorts. Per-centage of tar.	Per-centage of oil from tar by weight.	Refined oil from 1 ton tar, gallons.	Peat distilled in kilns. Per-centage of tar.	Per-centage of oil from tar by weight.	Refined oil from 1 ton tar, gallons.	—
1. Mixed light and dense turf (Philipstown	33·5	2·000	58·8	155	—	—	—	Sir Robert Kane and Mr. Sullivan.
2. Light surface turf (Allen)	21·0	3·577	46·1	121	2·510	55·3	144	
3. Dense peat (Allen)	29·7	2·767	43·8	115	2·395	43·1	113	
4. Light fibrous turf (Tickuevin) ..	30·3	2·916	70·2	184	—	—	—	
5. Light fibrous turf	,,	2·344	64·2	168	—	—	—	
6. Light fibrous turf (Shannon) ..	17·5	4·417	38·2	100	—	—	—	
7. Dense peat (Shannon)	53·3	1·462	70·1	184	2·270	50·0	132	
Average ..	—	2·787	55·9	147	2·391	48·5	128	
8. Dense mountain peat (Antrim) ..	—	—	—	—	4·440	—	—	Dr. Hodges.
9. Lews peat ..	68·0	9·085	42·161	111	5·000	41·167	107	
10. Do. do.	,,	—	—	—	,,	42·000	112	

On the other hand, it will be seen that the amount of tar represented as obtainable from the Irish peat is very small, whether the peat was distilled in close retorts or in open kilns. It varies from about 1·5 to 3·5 per cent., the average yield of the different samples tried being only 2·5 per cent.; while the Lews peat gives a very much larger per-centage of tar, even when worked in kilns. It must be borne in mind, however, that all the varieties of Irish peat above referred to are "bog peat," the only results quoted by Sir Robert Kane for mountain peat being those obtained in 1850 by Dr. Hodges, of Belfast, from an experiment conducted by him in Antrim with about 50 tons of peat.

Taking the average of these results, the Irish bog peat would yield about 357 gallons of refined oils from the 100 tons. Now, if the oils and paraffin are alone taken into account as the commercially valuable products from the distillation of peat, and assuming the cost of peat to be 2s. per ton, as set down in Sir Robert Kane's report, the tar at the above rate of production would cost, for raw material alone, about 4*l.* per ton, and the cost of peat, equivalent to one gallon of refined oils, would be 7d. Adding to this the cost of making the tar and refining the oil, as amounting jointly to 1s. per gallon, the total cost of the refined oil would be 1s. 7d. per gallon. It is not very probable that, at this rate of cost, the manufacture of these products from peat would be very remunerative; but in Sir Robert Kane's report, which has especial reference to Mr. Rees Reece's project for working peat, other products besides the oils and paraffin are taken into account as adding to the profits that might be expected from this undertaking. These products are sulphate of ammonia, acetate of lime, and wood naphtha; and so much were they regarded as a source of profit to be anticipated from the working of peat, that, in the prospectus of the Irish Peat Company, they were set down as furnishing more than one-half of the expected profits of the works. The values assigned to these products in Sir Robert Kane's report are not quite so great as regards their amount, as those stated by Mr. Reece, but they are nevertheless considerable, being for the 100 tons of peat as follows:—

Mr. Reece.

Sulphate of ammonia, 20 cwt. at 12s.	£12	0
Acetate of lime, 14 cwt. at 14s.	9	16
Wood naphtha, 52 gals. at 5s.	13	0
	£34	16

Sir R. Kane and Mr. Sullivan.

Sulphate of ammonia, 20 cwt. at 12s.	£12	0
Acetate of lime, 4 cwt. at 14s.	2	16
Wood naphtha, 52 gals. at 5s.	13	0
	£27	16

These results have an attractive appearance even in both cases; but a closer examination of the subject of peat working, from a commercial point of view, led Mr. Paul to the conclusion, that it was a fallacy to regard these products as constituting a source of profit to be obtained in working peat. He considered that no reliance should be placed on these products; that they should be regarded strictly as waste or bye products; and that the question, whether peat can be worked remuneratively, must be determined by regarding the oils and paraffin alone as the staple produce. If these could be obtained in such proportion and at such a cost as to afford a profit, it might then be worth while to work up the waste products of the works for the sake of the ammoniacal salts and other materials they would yield.

Keeping this principle in view, he then sought to determine, by actual trial, what amount of tar could be obtained from the Lews peat, which analysis had shown to give a much larger amount of tar than the Irish peat examined by Sir Robert Kane. An experimental distillation of the Lews peat in a close retort gave the following result:—

Tar	9·805
Charcoal	31·500 containing 1·25 ash = 3·834 per cent.
Water	37·875
Gas	21·540
	100·000

which was confirmed by subsequent trials on a larger scale.

The tar thus obtained yielded 42 per cent. of refined oils and paraffin, so that the 100 tons of peat would yield:—

	Tar.	Crude oils.	Refined oils.	Creosote.
Lews peat.	2097 gals.	= 1629 gals.	= 999 gals.	+ 630 gals.

In this case, taking the cost of the peat as before to be 2s. per ton, the quantity equivalent to one gallon of refined oil would cost only 2½d., and adding 1s. as the cost of manufacture, the refined oil would cost 1s. 2½d. per gallon, instead of 1s. 7d., as in the case of Irish peat.

It was, however, considered probable that, in working with close retorts, the charcoal obtained in one operation would not furnish sufficient fuel for the distillation of the subsequent charge of peat, and that, in this case, an additional element of cost would be introduced into the manufacture. At this stage of the inquiry, therefore, it became a question whether it would not be more economical to work with kilns, as was done at the Irish works. With regard to the results obtained at those works, Mr. Paul was of opinion that the small amount of tar obtained by Mr. Reece's method was mainly attributable to the use of the blast, and, as suggestive of this view, he referred to some data given by Mr. Reece, and quoted in Sir Robert Kane's report. Mr. Reece states that, in the experiments made in Antrim, in 1850, with a kiln 3 feet diameter and 15 feet deep, when the quantity of peat distilled was 1¼ ton in 24 hours, the produce of tar was 70 lbs. per ton = 3·1 per cent.; when 2 tons were distilled in 24 hours, the tar amounted to only 40 lbs. per ton = 1·8 per cent.; when 3 tons were distilled in 24 hours, the tar amounted to only 22 lbs. per ton = 0·98 per cent.; and when 9 tons were consumed in 24 hours, the produce of tar was only 2 lb. per ton of peat. In the experiment conducted by Dr. Hodges, which gave 4·44 per cent. tar, the distillation of 2 tons of tar in this kiln occupied three days. The same fact is pointed out in Sir Robert Kane's report as having been observed in the course of the investigation made at the Museum of Irish Industry by Mr. Sullivan.

This result Mr. Paul considered to be clearly attributable to the action of the blast of air driven into the bottom of the kiln, the peat having been burnt instead of being distilled; and this view of the matter led him to the conclusion that it would be advantageous, in working with kilns, to dispense with the blast as altogether useless, besides being very expensive, and to substitute for it a draught just sufficient to maintain the combustion of the charcoal at the lower part of the kiln, so as to produce the requisite heat for distilling the peat in the upper part of the kiln. It was considered, moreover, that the draught would also facilitate the escape of the tar vapour from the kilns in a much greater degree than the blast driven into the bottom of the kilns. This opinion was supported by learning the result of some experiments that had been made with a small kiln constructed in this manner, which had been worked for some time in Lews. In this kiln the draught was pro-

duced by means of a chimney placed at the further end of the condenser, and the yield of tar obtained with it was stated to be 5 per cent. This result was so far confirmed in some trials made by Mr. Paul with this experimental kiln, that when arrangements were made for erecting works to make six tons of tar a week, it was determined to construct a range of kilns of this description in preference to fitting up retorts, which, it was considered, would involve a greater outlay than kilns, and a greater expense for fuel and labour in working.

The analysis of the tar made with this experimental kiln showed that it yielded 41 per cent. of refined oils and paraffin; and an experimental distillation of about a ton of the tar showed that it could be easily worked and made to furnish products in every respect equal in quality to the hydrocarbon oils obtained from other sources. The quantity of refined oils and paraffin obtained from the ton of this tar was 112 gallons, or 42 per cent. by weight, and 48 per cent. by measure.

The inquiry made into the cost of this tar as a material for preparing the oils showed that it could probably be supplied to the rectifying works at something less than 5*l.* per ton. The cost of the peat on the moor was at that time 2s. 6d. per ton, and there were satisfactory reasons for expecting that it could be obtained at a less cost. These expectations were subsequently realised, peat having been obtained by contract, successively, at 2s., 1s. 9d., and 1s. 6d. per ton, and some cut under Mr. Paul's direction cost only 1s. per ton. But, whatever might be the rate at which peat could be obtained, he felt convinced that 5*l.* per ton for the cost of the tar, yielding at least 100 gallons of refined oil and paraffin, was the maximum price that would admit of profitable results being obtained. This limit of cost having been fixed for the tar, it became necessary to make the arrangements of the works for producing the tar with the strictest regard to economy of labour. At the same time, it was hoped that a yield of tar might be obtained from the peat, by means of kilns, greater than 5 per cent., and more nearly approaching to the amount obtained with close retorts, as the arrangements connected with the experimental kiln, with which 5 per cent. of tar had been obtained, were in many respects highly defective. The influence of an increased yield of tar on the cost of the oils was shown to be very clearly apparent from Table II., in which the quantity of peat worked per week is taken as 100 tons, and the yield of tar varying from 1 to 10 per cent.:

TABLE II.

Per-centage yield of tar from peat.	Quantity of peat worked per week. Tons.	Tar produced. Tons.	Tar produced. Gals.	Refined oil and paraffin. Gallons.	Cost of tar made. Peat.	Cost of tar made. Labour.	Cost of tar made.	Cost of tar per ton. £	s.	d.	Cost of tar equivalent to 1 gal. refined products; these being 100 gals. = 1 ton tar. s.	d.	Cost of refining per gallon. s.	d.	Cost of refined oils per gallon. s.	d.
1	100	1	233	107	10	10	20	20	0	0	4	0	0	6	4	6
2	,,	2	463	214	,,	,,	,,	10	0	0	2	0	,,		2	6
3	,,	3	699	321	,,	,,	,,	6	6	8	1	4	,,		1	10
4	,,	4	932	428	,,	,,	,,	5	0	0	1	0	,,		1	6
5	,,	5	1160	535	,,	,,	,,	4	0	0	0	10	,,		1	4
6	,,	6	1398	642	,,	,,	,,	3	6	8	0	8	,,		1	2
7	,,	7	1631	749	,,	,,	,,	2	17	2	0	7	,,		1	1
8	,,	8	1864	856	,,	,,	,,	2	10	0	0	6	,,		1	0
9	,,	9	2097	963	,,	,,	,,	2	4	6	0	5½	,,		0	11½
10	,,	10	2330	1070	,,	,,	,,	2	0	0	0	5	,,		0	11
5	120	6	1398	642	12	10	22	3	13	6	0	9	,,		1	3
,,	200	10	2330	1070	20	10	30	3	0	0	0	7½	,,		1	1½

These preliminary matters having been satisfactorily disposed of, preparations for erecting works were commenced in the early part of 1859. The tar kilns were cylindrical brick chambers 5 feet diameter and 12 feet high, with a fire-grate of about 2 feet area at the lower end, and a hopper, with a lid at the top, for introducing the peat. Ten of these kilns were constructed side by side in a block of brickwork. From the side of each kiln passed a pipe 12 inches diameter, which was connected with a main 3 feet diameter, extending round the whole range of kilns, and into which the tar vapour from the kilns was discharged. From this main the vapour passed into a series of pipes 12 inches diameter, arranged on cisterns, much in the same manner as the condensers of gasworks, but with the difference that there was no water-joint. After passing through this condenser, the uncondensed gases were discharged into a brick chamber, with numerous partition walls, and thence into a large flue running for about 50 yards up the side of a hill, on the top of which was placed a chimney 30 feet high.

A tramroad ran along the top of the kilns, communicating with the tramroads diverging through the moor, for bringing up the supplies of peat; and as the peat burnt away at the fire-grates, a fresh quantity was introduced at the upper ends of the kilns. This charging required to be repeated every two or three hours. The product collecting in the condenser cisterns was a thick, creamy mixture of tar and water, of a pale sulphur colour, from which the tar was separated by heating it in a large boiler, and skimming the tar off the surface.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Pyrophosphate of Iron, by Professor CHAPMAN.

THE pyrophosphate of iron, a white and tasteless powder, resembling prepared chalk, is obtained as a gelatinous precipitate in the reaction between the pyrophosphate of soda and the tersulphate of iron in solution. A given proportion of citric acid in solution is neutralised by liquor ammoniæ, as shown by test paper, when pyrophosphate is added, and the liquid boiled until the salt is dissolved. We now have the citro-ammoniacal pyrophosphate of iron in solution; from which we may obtain the solid salt by evaporating to a thick consistency, and then spreading the product on large plates of glass. It takes the form of lamellæ of greater or less thickness; these, when thin, are flaky, brittle, and of a yellowish green colour, but when more massive are of a duller and deeper green, and of a resinous appearance. This salt, which has a slightly saline taste, may be made into pills, or dissolved in water in any proportion, by the aid of heat. The solution does not require any addition to disguise it, as the saline taste is trivial and not unpleasant, though sugar and a flavouring ingredient may be added to suit the caprices of patients. Syrup completely conceals the iron, and renders the preparation tasteless. This may be made of any desired strength. I usually give from three to five grains of the pyrophosphate three or four times a-day.

The solid salt contains its ingredients in the following proportions to the hundred parts:—

Pyrophosphate of iron (anhydrous) . .	48·8
Citrate of ammonia (neutral)	34·66
Water in combination	16·54
Total	100·00

The 48·8 parts of the pyrophosphate contain 7·27 of metallic iron. It is a sesqui-salt, represented by the formula $2Fe_2O_3, 3PO_5$, and formed by the reaction between three equivalents of the pyrophosphate of soda, $3\ (2NaO, PO_5)$, and two of the tersulphate of iron $2\ (Fe_2O_3, 3SO_3)$.

The citro-ammoniacal pyrophosphate of iron affords certain marked advantages over the preparations of iron hitherto in use. Its tastelessness in solution with sugar, and elegant appearance, in our day, when the nauseous doses of the older practitioners will not be tolerated, is an important item in the case of children, or adults even, when the employment of a remedy is demanded for a period of time. There is every reason for presenting our medicines in as palatable and pleasant a form as possible. In addition, there are many persons of a nervous, delicate organisation, particularly females, who cannot take the ordinary preparations of iron. They disorder the stomach—in their language are too heating—and thus not only fail to be assimilated, but, by perverting the gastric and intestinal secretion, seriously interfere with the digestion. Hence, instead of enriching the blood by new materials, we are merely cutting off the original supply, imperfect as it is, and making the gastric surfaces a centre of morbid irritation. We observe a similar but more complete abeyance of the nutritive functions, in most patients much reduced by an exhausting disease. However much iron may be indicated, it cannot be borne, much less appropriated, by the absorbents until the digestion is restored by bitters and stimulants.

A marked peculiarity in the pyrophosphate of iron is the fact, that it will, scarcely ever, in any of these cases disagree, and very frequently patients, who cannot tolerate the ordinary forms of iron, will bear this well, and receive great benefit from its use. Like the others, it may fail to add to the blood a richer pabulum, from some fault in the vital processes of nutrition; yet, unlike these, it will not aggravate the disorder for the relief of which it was given. Where the digestive powers are unimpaired, it matters little what preparation is selected, as far as its tonic action on the blood is concerned; since all—certain chemical reasons to the contrary notwithstanding—will fulfil this indication satisfactorily. The new salt will supply the iron to the blood-globules as promptly, but not more so, than the others.

It has, however, another and more important property which has entirely escaped attention; that adds new virtues to the iron, and bestows on this special compound advantages possessed by none other in the Materia Medica. These arise from the pyrophosphoric acid. This acid, or the element, phosphorus—which has not been definitely determined by chemists—exists alone in a free state in the great ganglionic nervous centres. According to Frémy, the phosphorus is combined with the brain-fat, forming what he calls the oleo-phosphoric acid. This, by boiling for some time in alcohol or water, splits up into olein and phosphoric acid. This brain-fat, cerebric acid or cerebrin, is the protein-body of the nerve-centres, and its great peculiarity is the amount of phosphorus its contains. Frémy makes it 9 parts to 1000. There are many other protein-bodies with specific properties that effect peculiar vital transformations, such as, for example, the nitrogenised element in the gastric juice, the pancreatic secretion, casein, and the albumen of eggs or blood. This nitrogenised element, by its presence, without any chemical union with the other ingredients, forms a great diversity of new compounds from the same plasma; as, for example, the various secretions from the same blood.

It is, at the present time, tolerably well established (Virchow, Kölliker, Bennett) that all life starts from, and is sustained by, the agency of cell-growth, and that even morbid actions form no exceptions, but are carried on by the same organic forces. These cells, in their walls, nuclei and contents, contain a peculiar and distinctive protein-body; and being distributed universally in the solids and fluids of the body, are the great vital factors—the pervading life-force—by which organic functions are manifested. Formerly, it was thought that the peculiarities of this nitrogenised, albumenoid substance, or protein-body, were due to the nitrogen in its composition, but it has since been found that phosphorus and sulphur are usually present. Both of these are contained in the albumen of the egg or of the blood, and in the casein of milk—fluids that contain every element necessary for the perfect development of living creatures. Milk is the most perfect type of the various constituents, and their proportions, that should exist in our diet

Nitrogenised Elements in Albumen (Mulder).

Carbon	52·97
Hydrogen	6·81
Nitrogen	15·11
Oxygen	23·54
Sulphur	1·57
Phosphorus	·40

Nitrogenised Elements in Casein.

Carbon	53·61
Hydrogen	7·11
Nitrogen	15·47
Oxygen	17·99
Sulphur	1·11
Phosphorus	·47

It thus appears evident that phosphorus holds an important place amongst the other elements that contribute to cell-life and nerve-power; but as all nitrogenised food contains it in the same proportions as it exists in the human organism, we cannot select a better remedy for defective nutrition than these ready-formed products. We should naturally suppose, what I have found by experience, that animal food would be the proper agent to restore flesh to an emaciated patient, since it contains each constituent necessary to its formation. At least, I have not found the phosphoric acid to add anything to the iron in such cases. Phosphoric acid united to a base—lime—exists in all the fluids and solids of the body. The phosphorate of lime is formed in the vegetable from the elements in the soil; whence we derive it directly, or secondarily, through animals who have fed upon them. The phosphatic salts are received as such, and are probably carried through the blood to the solids, particularly to the bones, without suffering decomposition and re-construction; excepting, perhaps, in a small ratio. It scarcely could be requisite, when the supply presented to the stomach is always so abundant, to administer any phosphatic salt for the purpose of adding the phosphate of lime to the blood, and thence to the bones. The defect of this saline in the bones is not due to the lack of the elements in the food, but to a fault in nutrition. When this is obviated, the common articles of diet will supply all the materials required. We conclude, therefore, that phosphorus is not demanded medicinally to build up the nitrogenised tissues of our bodies, nor are the phosphates to form the bones, since they are all presented to the blood in great abundance.

Phosphorus is regarded by therapeutical writers as a cerebral stimulant, exalting nerve-power directly, but the action of the heart indirectly, and only a moderate degree beyond the normal tension. Of all the organs,

the reproductive are most sensibly affected; a fact satisfactorily accounted for in the male by our knowledge that the semen contains, according to Kölliker, over 2 per cent. of a phosphoretted fat. As throughout nature nothing is without a use, and every element has an importance, though we may fail to discover it; so we may safely conclude that phosphorus must exist in the nervous centres and the spermatic fluid as an integral constituent in their chemical composition. Probably it plays an important part in the normal excitability, and is intimately connected with the manifestation of mind, and the generation of the nervous influence.

In many conditions occurring in disease there might be a lack of this constituent, in a due proportion; precisely as there is of iron in anæmic states of the blood, when our only resource would be to present it in some assimilable form to the system, as there are no substitutes for the elementary bodies. In the case of phosphorus, here has always lain the difficulty; undergoing a slow oxidation or combustion at ordinary temperatures, even when floating on water, its substance would be burnt in the stomach, and a small particle adhering to the mucous surface would occasion irritation or inflammation. It could not be absorbed as phosphorus, and could only be remedial by the phosphorus and phosphoric acids that are formed. These would undoubtedly combine in the stomach with the earthy or alkaline bases, and be reduced to the state of the phosphates existing in the food. These, we know, suffer but little change in the blood, being found unchanged in all the solids and fluids, but particularly in the bones. From them, however, in normal, healthy nutrition, the phosphoric acid in the nerves-centres must be derived. Should there be a great depression of vital power, the acid is not liberated from its combination, in the same manner, as we know, the iron is not, from the materials for digestion. The iron set free by assimilation in the blood is appropriated by the hæmatin; the phosphorus by the brain-fat. In hydræmia we give the iron in an easily assimilated form; one that does not tax the vital powers in separating it from a chemical combination, and straightway the blood begins to regain its colour, and strength and vigour are infused into every organ. When a certain stage of recuperation has been obtained, as shown by a more florid blood and a stronger pulse, the iron will be readily appropriated from the food, which, normally, is the source whence it is always obtained. The fault, originally, lay not in the absence of iron in the substances presented to the blood, but in an imperfect elaborating power, which failed to assimilate it. In like manner, I think, phosphoric acid may, from the same defect, not be separated from its compounds, and thus the ganglionic nervous centres be wanting in their normal stimulus. Hence would arise many nervous and neuralgic diseases, and nervous complications in many forms of debility. It is necessary for us to pass the phosphoric acid into the blood. This we can only do by giving it in a saline state, with a base that would be assimilated, and thus set it free. This is accomplished by the iron, which we know, in ordinary medicinal doses, is used in the blood; in other words, is appropriated by the hæmatin, and cannot be detected by any tests. It is a natural constituent in the red globules, and, consequently, not being foreign to the body, behaves precisely as any of the elementary principles that form its structure. Strictly speaking, it is a food, and must be supplied as much as starch, sugar, oils and flesh.

The pyrophosphate of iron has another property scarcely to be expected, and one we should never discover except by actual observation. All of the common preparations of iron are apt to oppress the stomach, coat the tongue, and destroy the appetite, especially when the patient is much debilitated. Many, from a delicate, sensitive organisation, cannot, under any circumstances, take iron with profit, it being, in their language, too heating. The pyrophosphate is friendly to the stomach, will never cause any irritation of the gastric surfaces, and, to our knowledge, has never disagreed with any patient, however incompatible the other forms may have been. Besides, it appears to possess a tonic power, and will restore the appetite and digestion after the failure of bitters, quinine, wine, &c., often in extreme cases of anæmia, amenorrhœa, and chlorosis, as we have witnessed in many instances in our obstetric clinique. It seemed to afford just the grade of stimulus required by the stomach, and the improvement, thus initiated, continued without interruption, under this single remedy, to the complete cure of the patient. This acceptability, friendliness, corrigent and roborant action of this form of iron on the digestive organs is a valuable peculiarity, which renders it, in many persons and in many states of disease, superior to all others, and perhaps to any drug whatsoever. Besides, its tastelessness, when dissolved in syrup, is a great recommendation in this age of sugar, when patients desire to die *sweetly*, and will not endure anything nauseous or unpleasant, though death be knocking at the door. This we might expect in children who *bring up* their parents to a tolerably high state of discipline, and issue their orders of command from the cabinet councils of the nursery. We medical men, taking the world as we find it, are obliged to render our doses as palatable as possible for babies, both great and small. This object, without detriment in the choice of our means, is singularly and notably attained by the use of the syrup of the pyrophosphate of iron.—*From the Chicago Med. Examiner.*

INTERNATIONAL EXHIBITION.

Class XIII.

Philosophical Instruments, and Process Depending upon their Use.

The last thing which a chemist uses, but the first in importance to him, is a balance. On the accuracy of this depends the usefulness of his results. In a display of chemical apparatus, then, we may very properly look first at the balances. The number exhibited in the English department is small; but, to all appearance, the instruments are of great excellence. Mr. Oertling, from his recognised position in this branch of manufacture, might be expected to show instruments of great delicacy and finish, and such will be seen in Case 2926. The workmanship of these is excellent, and, no doubt, their accuracy may be perfectly relied on. The large bullion balance shown is a beautiful instrument, and a small, portable assay balance is worthy of notice. More delicate balances and instruments of equal finish are exhibited by Messrs. Kiessler and Neu in Case 2922, who show an assay balance, which they aver will turn to $\frac{1}{15000}$th of a grain when loaded to 30 grains. They also show a chemical balance, which will turn to $\frac{1}{1500}$th when loaded to 1500 grains. The makers of these instruments have very properly received a medal. A very neat little balance is also shown by Mr. Griffin in his large Case 2904. The display of this gentleman well deserves the medal he has received, and ought to receive

a more detailed notice than we can well give here. It contains all those useful contrivances for the laboratory which are to be found in Bunhill Row, the apparatus for volumetric analysis, which Mr. Griffin has done so much to simplify, the furnaces for which he is remarkable, and the dialysers he has so well contrived. A very useful-looking mercurial pneumatic trough, with inclined supports for the tubes, the contrivance of Professor Liveing, is also shown. A good portable laboratory for engineers or physicians, some very useful models for lecturers, powerful magnets, and excellent apparatus of all kinds, make the case deserving of the highest commendation. In Case 2919 Messrs. Jackson and Towson have also a good display of apparatus. They, too, exhibit a portable laboratory, which looks a useful working affair, and not a toy, as such things often are. Some small and neat blow-pipe cases look likely to be useful to the mineralogists and metallurgists on their travels. Small stills for estimating alcohol in wines, and a pretty little apparatus for estimating the value of benzole, will be found extremely useful to commercial men who have not all the conveniences of a laboratory. Some well-made air and water baths in the case deserve notice. In 2861 Messrs. Bolton and Barnitt exhibit some exceedingly well-made glass apparatus, and other useful things. Among the novelties in this department the visitor will notice the Ebonite Plate Electrical Machines, a very fine specimen of which will be seen in the collection of Messrs. Murray and Heath, 2937. The value of this application of such a material as ebonite will be readily appreciated by those who have had the misfortune to get more than one glass plate broken. Two other things in the last-mentioned case are also deserving attention—the improved apparatus of Mr. Heisch for observing circular polarisation in liquids, and a permanent electric lamp, without the use of clock-work, and adapted for any sized battery. We have never seen this latter instrument at work, but have no doubt it well fulfils its purpose. Messrs. Horne and Thornthwaite exhibit (2916) a collection of their own optical and electrical apparatus of great finish and excellence, including a powerful Rhumkorff's coil, the apparatus for spectrum analysis, with universal stand and micrometer eyepiece, and polariscopes. There are also in the case some large specimens of Herapath's artificial tourmalines—the iodide of quinine. Mr. Ladd shows in 2925 many examples of the optical and electrical apparatus for which he is justly renowned, and for which in this Exhibition he has deservedly received a medal.

There are several exhibitors of hydrometers, saccharometers, gravimeters, and instruments of that kind. Ladd and Oertling have a new saccharometer for brewers, which shows the specific gravity and the calculated weight in lbs. per barrel, without the trouble of referring to a table. Mr. Buss (2870) has a good collection of well-made instruments, and a neat-looking revenue still for estimating spirit in wine. The gravimeter for taking the specific gravities of solids as well as liquids is a very useful instrument for ordinary purposes, and Mr. Buss exhibits some well-made specimens. The collection of microscopes and other optical instruments displayed by Mr. Ross (2952), Mr. Dallmeyer (2888), and Messrs. Smith and Beck (2964), speak for themselves, and fully sustain the reputations of the exhibitors. Messrs. Newton and Co. (2940) have an excellent display of apparatus of various kinds, with some useful astronomical models for educational purposes. Among the wonders of this Class we may include, with Mr. Babbage's calculating machine, the apparatus of Mr. Peters for microscopic writing. The latter is not shown at work; but an adaptation of it by Mr. Webb is shown close by. Mr. Webb has effected a novelty in making use of the machine for engraving on copper-plates, which, considering the exceeding minuteness of the writing, are printed wonderfully well. Our readers will understand that the filling such minute lines with ink is attended with some difficulty; but the difficulty has been completely surmounted. The micrometers shown by Mr. Webb are very clearly engraved, and measure (one of them at least) the two hundred and fifty-sixth millionth of an inch. Nobert's lines are also clearly engraved by the exhibitor. In Case 2906 Mr. Hart shows a well-made electric lamp for throwing spectra on screen, and a powerful induction coil. In 2883 Mr. Cox has an excellent lamp for the lime light, with contrivances for burning mixed gases, and securing an uniform light. Mr. Young's carbon plates for batteries and electrodes (2997) deserve notice for the ingenuity and perseverance displayed by the maker in bringing them to such perfection. Our readers will find a description of the means used for preparing them at page 135, Vol. i., Chemical News.

The display of meteorological apparatus is very large. Negretti and Zambra (2939) exhibit a large number of self-registering thermometers of great delicacy and accuracy, and some of great ingenuity, as the "vacuum solar radiation thermometer," and the "terrestrial radiation thermometer." The deep-sea sounding thermometer is an ingenious instrument, on much the same principle as Mr. Wentworth Scott's (2955), described at page 98, Vol. i., Chemical News. Mr. Casella's instruments (2874) are also remarkable for neatness of construction and delicacy. The new mercurial minimum thermometer, described at page 235, Vol. iv., Chemical News, continues to attract the attention of scientific men, and a large number is exhibited. The rest of the instruments in this Case are worthy the close attention of those who devote themselves to meteorological observations. Ingenious instruments are also exhibited by Messrs. Adie (2846 and 2847), and Mr. Hicks, of Hatton Garden (2911). The collection of instruments from the Kew Observatory, exhibited by the British Association (2865), must be dismissed at present with the simple mention of them, as must also the collection of the International Decimal Association (2998). To both of these we may return at some future time.

NOTICES OF PATENTS.

2161. *Improvements in the Manufacture of Animal Oils, the said Improvements relating more particularly to the Process of Refining them to be Used for Lubricating Purposes.* H. W. Spencer, Stepney Causeway, Commercial Road, London. Dated August 30, 1861.

The patentee claims the process of refining animal oils by removing from them the albuminous, gelatinous, or such-like substances, which they contain, by means of tannin, or any substance, like nut-galls, catechu, or oak-bark, containing tannin; such purification being effected by contact and filtration, and with the special object of rendering them better fitted for lubricating purposes.

2197. *Extracting Copper and Silver from Ores.* G. Bischof, Swansea. Partly a communication. Dated September 3, 1861.

The first part of this invention relates to the preparation of the copper ores, with the object of separating a large proportion of the earthy impurities previously to smelting.

For this purpose, the poorer descriptions of ore, which usually contain much limestone or dolomite in admixture, are subjected to a preliminary calcination in a limekiln, whereby the gangue is reduced to the condition of ordinary quick lime, whilst, by keeping the temperature moderated, the copper and silver compounds remain unaffected. The product is then washed in a stream of water to remove the hydrates of lime and magnesia, when the heavier particles of ore will rapidly subside, and constitute a material sufficiently rich in metals to be worked advantageously by one of the processes hereafter described. The smelting operation commences in the ordinary way, and is carried out for the purpose of obtaining the usual product, termed regulus or coarse metal, and which consists of the mixed sulphides of copper and iron. In the production of this compound a judicious selection of ores is made, so that the mixed material introduced into the furnace may contain about five parts of iron pyrites for each part of copper; and the fused regulus obtained is finely pulverised, and afterwards calcined for a period of about five hours, at a low red heat, in a furnace or muffle, so constructed that the products of the combustion of the fuel are not allowed to come into contact with the material spread out upon the hearth, but, on the contrary, a free supply of atmospheric air is admitted, and caused to pass over the surface of the heated regulus, by which means a thorough oxidation is insured, and the disulphide of copper contained therein converted, for the most part, into soluble sulphate of copper. In order, then, to provide for the evaporation of the copper liquors, afterwards obtained by lixiviation, the waste heat of the calcining furnace is employed, and this part of the process conducted in reservoirs placed beneath the muffle, or in other positions adjacent to the heated flues. Inasmuch as the sides and bed of the calciner are not required to be subjected to very high degrees of temperature, they may be constructed of plates of iron or clay. After dissolving out the sulphate of copper, by treating the roasted product with water, the insoluble portion, which still contains copper, is taken into solution by digesting with dilute sulphuric acid, using by preference an acid of proper strength (one part by measure of concentrated acid diluted with twenty parts of water), obtained directly from the sulphurous vapours, which, instead of being allowed to escape into the atmosphere during the roasting of the ore, are conducted into a leaden chamber adjoining the muffle-furnace. Instead of operating as above to obtain a salt of copper, the metal itself may be reduced by scrap iron, collected, dried, and melted, so as to furnish marketable ingots. In the event of silver being contained in the ores under treatment, special precautions are taken to exclude the presence of chlorides from the acid, and generally throughout the process, so as to avoid loss of the precious metal by precipitation in an insoluble form. The use of sulphate of silver is recommended as a means of purifying the dilute acid from adventitious chlorides, the amount required being proportioned to the degree of impurity.

The instructions contained in the foregoing specification bear a general resemblance to the details furnished by Mr. Frederick Bankart, in his patent, dated August 7, 1845, for "improvements in treating certain metallic ores, and refining the products therefrom." The main feature of difference appears to consist in operating upon the product known as "coarse metal," instead of submitting the ore in bulk to the process of roasting; and it is not unlikely that this modification may constitute an important improvement upon the system originally introduced by Mr. Bankart. With regard to the preliminary purification of the ore, there is no question to be raised against the possibility of separating lime and earthy impurities by burning and washing in the manner described.

Grants of Provisional Protection for Six Months.

2348. Harper Twelvetrees, Bromley, Middlesex, "Improvements in the preparation of washing powders, soap powders, and cleansing crystals."—Petition recorded August 22, 1862.

2552. William Watson, and William Henry Watson, Harrogate, Yorkshire, "An improved process or processes for the preparation of certain colouring matters from aniline."—Petition recorded September 17, 1862.

2667. George Jordan Firmin, Millwall, Poplar, London, "Improvements in the treatment of certain salts of potash and lime."—Petitions recorded October 2, 1862.

2669. John Harrop, Manchester, and James Wadsworth, Salford, Lancashire, "Improvements in deodorising refuse, organic, fœcal, and urinous matters, and in a method of utilising coal and other ashes, and in machinery or apparatus connected therewith for producing a portable manure therefrom."

2675. Alexander Dalrymple, Eyre-street, Sheffield, Yorkshire, "Improvements in the processes of depositing metals, by galvanic action, either with or without the aid of galvanic batteries, and in the ornamentation of metal surfaces thereby."

2698. James Newnam, Crayford, Kent, "Improvements in apparatus for crystallising and for evaporating."

Notices to Proceed.

1718. John Keeling, Reading, Berkshire, "Improvements in apparatus for the manufacture of gas."

1729. George Thomas Jourdain, St. Paul's Terrace, Canonbury, London, "Improvements in treating cocoa-nut oil."

1746. John Ingham and William Picard Wood, Valley Dye Works, Bradford, Yorkshire, "Improvements in preparing colouring matters for dyeing and printing."

1776. Robert Hicks, Kensington Park-terrace, London, "Improvements in the manufacture or preparation of paints, pigments, and colours."—Petitions recorded June 14, 1862.

1787. John Hunt, Birmingham, "An improvement or improvements in bronzing or colouring articles of copper or alloys of copper."—Petition recorded June 17, 1862.

1796. Joseph Kellow and Henry Short, Delabole, Cornwall, "Improvements in the manufacture of blasting powder."—Petitions recorded June 17, 1862.

1913. Thomas Parker, Woodhouse Carr, Leeds, Yorkshire, "Improvements in tinting or dyeing fabrics composed of mixed animal and vegetable fibres."—Petition recorded June 30, 1862.

1924. Eugene de Labastida, Hart Street, Bloomsbury Square, London, "A new method of manufacturing India-rubber articles by the simultaneous combination of pressure and vulcanisation."—A communication from Albert Cohen and Charles Vaillant, Harbourg-upon-Elbe, Hanover.—Petition recorded July 2, 1862.

2565. William Glass, Princes Street, Stamford Street, Lambeth, Surrey, "Improvements in the treatment of sulphuret of antimony, and in obtaining products therefrom."—Petition recorded September 19, 1862.

2627. Charles Denton Abel, Southampton Buildings, Chancery Lane, London, "A new or improved purifying and preservative lotion for the mouth."—A communication from Johann Georg Popp, Vienna, Austria.—Petition recorded September 26, 1862.

CORRESPONDENCE.

An Explanation of the Sodium Spectrum.

We have received the following from a correspondent, and print the greater part as received:—

"Prepare a straight, slender platinum wire, with a filmy coat of pure chloride of sodium, by fusing the salt till it runs in a globule down to the end of the straight wire; it is then to be struck off, and the filmy coating of chloride

of sodium alone to be left on the wire. Hold the platinum wire in the apex of the blue flame of a large paraffin candle, worked by a blast from a Platner's blowpipe, from which the nozzle has been removed, and which has been inserted into the air tube of Griffin's water-pressure blowpipe. A magnificent sodium flame will then stream forth like a meteor from the transparent platinum, the heat being of the intensity produced by galvanism just before fusion of the metal. Remove the wire from the flame, and examine it, when cold, in the sun's light. The film still remains as it was prior to the experiment. The phenomenon of the sodium flame is, therefore, caused by the vibrations of the particles of the sodium which have not left the wire, and which vibrations are communicated to the luminiferous ether, rendered sensitive by the great heat. When this vibration is passed through the slit of Bunsen and Kirchhoff's apparatus, the ether is cooled as it passes through the prism, except about the characteristic band, which alone is bright, the rest of the spectrum being dark from cessation in the vibration of the cooled ether, cooled by the prism, as the hot gas is cooled by the wire gauze of Davy's lamp.—I am, &c.

"P. N. H."

[We are obliged to omit the author's notions of the forms of the soda atoms when hot and cold, as they would require a diagram to illustrate them. We may say, however, that he believes the atoms, when cold, to be spherical; when hot, ellipsoidal.—Ed. C. N.]

Balloon Ascents.

To the Editor of the Chemical News.

Sir,—May I be permitted to remark, in connection with the letter of Mr. John A. R. Newlands, F.C.S., in your number of the 18th inst., that his idea for rendering possible balloon ascents to greater altitudes than that attained by Messrs. Glaisher and Coxwell, is one which has been printed and published for a considerable length of time, and the minutiæ of the method much more fully entered into than is done in your correspondent's letter.

The late Edgar Allan Poe, in his "Tales of Mystery, Imagination, and Humour," gives a circumstantial account of the adventures of Hans Pfaal during a balloon voyage, accomplished by means very nearly identical with those proposed by Mr. Newlands, and which are described at considerable length, and with great attention to the details.

If we are to give credence to his veracious biographer, the process achieved a most complete and signal success, for he relates that Herr Pfaal terminated his voyage by landing, all safe and sound, upon the moon.—I am, &c.

Graham Stuart, F.G.S., &c.

Sheffield, October 27.

MISCELLANEOUS.

Chemical Society.—The first meeting of this Society for the Session 1862-3, will take place on Thursday, November 6, at 8 o'clock. Mr. Wm. Dancer will read a paper on *Hypobromous Acid.*

First License Under the Petroleum Act.—The first application made to the Court of Aldermen for a license under the Petroleum Act, was for permission to store benzole, which is neither "petroleum" nor "a product thereof." The applicant received a sort of provisional license for six months. The Metropolitan Board of Works has refused all licenses applied for, except one to Price's Candle Company, for storing Rangoon oil!!

Consolidated Emery Wheels.—Some public trials took place last week in the Machinery Department of the International Exhibition, of Warne and Co's Consolidated Emery Wheel (Coles, Jaques, and Fanshawe's patent). The patentees have availed themselves of Walton's oxidized oil—exhibited in Class IV., 1156—as a means of consolidating emery; the mixture being formed into wheels, and then subjected to a process analogous to that by which ebonite or vulcanite is produced from India-rubber. In this way a material of intense hardness and great durability is produced. The experiments we witnessed showed that a wheel of this material would grind with ease the hardest chilled iron, while steel and cast-iron were cut with remarkable facility. The invention will prove of the greatest utility to engineers by saving time and labour in filing and polishing large castings—this kind of work being done with great ease and quickness. One experiment showed that the wheel could be made available for cutting teeth in circular saws, and many other applications of the material were suggested by practical engineers. We were informed that the wheels are already in use at the North London Railway Works, Bow, and some other large engineering establishments.

The Oil Springs of America and Canada.—The following extracts from Alex. S. Macrae's circular for October may interest our readers:—The total exports from America and Canada (including refined) to the 1st October, are about 200,000 casks, or say over 600,000*l.*, and this under the most diadvantageous circumstances. With the advices of what is now loading at the various ports—with the branch line just opened from the Atlantic and Great Western Railway to the Oil Wells, as announced in my last—but, above all, with the extraordinary results herein recorded, enormous shipments may be expected; and it is easy to foretell that the value of the oil exported from America and Canada in 1862 (the first year of its European introduction), will exceed 1,000,000*l.* sterling. But even yet, one tithe of its dissemination is not effected. Britain has manipulated pretty freely, so has France and the German States, but so clamorous are they for more, that the export extension cannot be made sufficiently general. Spain, Portugal, Italy, and Russia have yet to receive it in the Crude form. *Crude.*—American, 20*l.* per tun! Who would have believed that such a price was either possible or probable in May last, when the article was a drug in the market at 8*l.*, with scarcely a friend to pay more than the freight? What sanguineness would not have been chided that premised such results? 1500 casks sold this week at 19*l.* to 20*l.*, and now little at the latter. And is the culminating point reached, with a stock of only 4000 casks, and the consuming season just beginning? Canadian, 13*l.* *Refined.*—The sales for the last two weeks are over 2000 casks, at 2s. 2d. to 2s. 4d., 2s. 5d. to 2s. 6d. being now the lowest quotations. Really white, 2d. above these quotations. The qualities that are at present coming over call for the highest commendation, the point of ignition being over 100°, and, therefore, meeting the requirements of the Government Bill. *Benzine or Spirit.*—An unlimited sale, at 2s. to 2s. 3d., according to specific gravity. No stock of American. 700 cases, 8 gallons each, in tins, sold at 17s. to 19s. per case. *Lubricating Oils.*—No American, and all sorts much wanted. Value, 12*l.* to 15*l.* for black and greenish, 16*l.* to 25*l.* for brown and yellow.—*Liverpool, October.*

ANSWERS TO CORRESPONDENTS.

Dr. Roscoe is thanked for his note.

P. N. H.—Received.

Teuto.—The two first terms have evidently been transposed, as you suggest. Write a note for publication, with calculations by each method.

M. P. S.—Sarracenia Purpurea. We will give some account of it next week.

Tozos.—Methods for the extraction of colchicia are given in Beck, Taylor, and Flandin; but we are not aware that it has ever been detected. The directions are general, and will serve for any alkaloid. The special reactions of colchicia are not given.

Books Received.—"Air and Water; their Impurities and Purification." By Henry Bollman Condy.

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PROPOSED ALTERATION OF THE GRAIN IN THE BRITISH PHARMACOPŒIA.

FROM the proceedings which we publish elsewhere, our readers will see that the General Medical Council have succumbed to common sense, and resolved not to interfere with the grain weight. They have determined, however, to retain the avoirdupois pound, as proposed, against which no objection can be made, and also the avoirdupois ounce, but discontinue the use of the drachm and scruple in the Pharmacopœia. As the values of these latter weights are not affected, they will, of course, be used in prescribing, as heretofore, but now as merely denominational weights. This is, perhaps, the most sensible resolution the Council could come to; and with this arrangement no practical difficulties need occur. We could hope that nothing now will impede the speedy publication of the Pharmacopœia; but we do not learn that the question of copyright has yet been settled, nor that the power to make the use of the Pharmacopœia compulsory has been obtained. In the meantime, we do learn that some of the new formulæ introduced are being prescribed, and that certain physicians are sending their patients to one or two establishments, as the sole possessors of these valuable recipes. Such conduct requires no comment; and, perhaps, it would not be beneath the dignity of the General Medical Council to notice the scandal.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Estimation of Copper in Ores, by M. FR. MOHR.

1. Oxygenated Ores, comprising oxide, suboxide, malachite, and phosphate of copper.

According to the richness of the ore to be assayed, treat from 5 to 10 grammes of material, reduced to impalpable powder, by a little weak sulphuric acid and nitric acid. Boil the mixture, evaporate to dryness, then calcine till it ceases to disengage vapours. The copper becomes transformed into sulphate, not decomposable by moderate heat, and very soluble in sulphuric acid; on the contrary, iron is converted into slightly soluble ferric sub-sulphate; lead, into insoluble sulphate. Nitric acid forms, with tin and antimony, oxides resisting the action of solvents.

When the capsule is cool, add distilled water, and boil; the filtered solution will contain all the copper, and small quantities of ferric sulphate. On treating this solution with zinc, the ferric salt is reduced, and the copper precipitated, by boiling, in a metallic state. To make sure of the complete precipitation of the metal, it suffices to treat a drop of the supernatant liquid by hydrosulphic acid. To free the copper from excess of zinc, treat the powder by hydrochloric acid until it ceases to disengage bubbles of hydrogen. Wash the matter freed from zinc with hot distilled water; the action of the air must be avoided when the solution is acid, because a portion of the copper would dissolve; but it is easy to avoid this inconvenience, by effecting the washing promptly. Dry in a water bath until no further loss of weight occurs. In this way a pure and dry copper is obtained, its weight indicating the richness of the assayed ore.

The presence in the ore of zinc, manganese, iron, cobalt, and nickel, as well as that of calcium and magnesia, does not affect the precision of the analysis, as zinc does not precipitate these metals.

2. Sulphuretted Ores. Operate as with oxygenated ores; only, as they are less easily dissolved, the treatment by sulphuric and nitric acid must be several times repeated, drying and calcining the metal between each treatment with the acid.

This method has the advantage of being applicable to all ores, whatever their composition, and of not necessitating a preliminary qualitative analysis; in the second place, the copper is separated from the metals (lead, tin, antimony), from which it is freed with difficulty by the ordinary methods; whilst the other metals (zinc, iron, cobalt, nickel) do not influence the exactness of the estimation, and may be disregarded.—*Répertoire de Chimie Pure et Appliquée.*

Analysis of the Diluvial Soil of Brabant, &c., known as the Limon de la Hesbaye, by Dr.* T. L. PHIPSON, *F.C.S., &c.*

THE curious geological formation known as the Limon de la Hesbaye, which extends from the Seine to the Rhine traversing Belgium from east to west, where it covers the whole of the province of Hesbaye, a great part of Brabant, Hainault, and Flanders, is exceedingly remarkable for its fertility. "It is to this deposit," says M. D'Omalius d'Halloy, "that we may attribute the richness of the most fertile countries of Belgium." It extends also over Picardy, stretching from the Seine to the other side of the Rhine, and is everywhere characterised by its great fertility, and the excellence of the vegetable mould to which it gives birth by culture. No fossils have as yet been discovered in it. It ranks among the modern post-tertiary or diluvial formations of geologists, and there exist on different portions of the globe similar modern deposits equally interesting in an agricultural point of view.

* Read before the British Association.

I have submitted this remarkable deposit to analysis, and its composition shows that, although the Limon de la Hesbaye contains upwards of 90 per cent. of sand, yet the chemical ingredients necessary to form a fertile soil are present in it in notable quantity; besides which, its porosity, which allows water to pass slowly through it, and admits the ingress of atmospheric oxygen, is an important condition of fertility. It dries completely when pulverised and exposed to the sun, but when in mass it retains moisture for some time.

When seen in mass, the Limon de la Hesbaye is brownish-yellow, becoming of a lighter colour when dry, and giving a whitish-yellow powder. Its specific gravity is about 2·00. It possesses a certain compactness, though it can be pulverised in the hands without much difficulty.

The sample analysed by me was taken in the neighbourhood of Brussels, from the centre of a stratification about two yards thick, and which had consequently never been submitted to cultivation. The result obtained is as follows :—

Moisture	traces
Organic matter and combined water	3·00
Ammonia	0·10
Potash and soda	0·23
Magnesia	0·07
Lime	0·40
Alumina, with a little oxide of manganese	1·20
Oxide of iron	2·56
Phosphoric acid	0·20
Sulphuric acid, chlorine, and carbonic acid	traces
Quartzous sand	92·24
	100·00

This composition coincides very closely with that of another deposit of limon, equally remarkable for its fertility and the readiness with which it is converted into excellent arable land. I allude to the celebrated tchornoïzen, or black diluvial soil of the Ukraine, which has been analysed by several chemists. It extends from the Carpathian mountains to the Urals, giving to the whole district included a characteristic fertility.

It is not my intention to discuss the geological origin of these deposits, which are so important to agriculture; but I may state here, that they are all post-tertiary formations, that they exist in several parts of the globe, and that the regions where they are present appear to be, in an agricultural sense, highly favoured by Nature.

Preparation of Solution of Ammonia in Water, by M. R. Frésénius.

The author advises the following process, used in his laboratory, for preparing a solution of pure ammonia :—

Mix 6·5 kilogrammes of ordinary commercial crystallised chloride of ammonium with 3·5 kilogrammes of sulphate of ammonia. Pass the mixture through a sieve, so as to break up the largest pieces. To hydrate of lime, prepared with 10 kilogrammes of lime and 4 of water, add the two ammoniacal salts in successive layers; then moisten the whole mass with 8 kilogrammes of water. Wash the gas in a Woolf's flask, containing pure water, pass it into a Liebig refrigerator, and conduct into a large balloon, containing 21 kilogrammes of distilled water. The Woolf's flask at its lower part has a tap, by which the liquid may be drawn off when too much of it accumulates, as generally happens, towards the end of the operation, by the attraction of the water vapour.

The use of chloride of ammonium and sulphate of ammonia possesses the advantage of furnishing a residuum, which is easily taken from the retort; the formation of sulphate of lime prevents the chloride of calcium from taking the form of a mass; moreover, less water is required when operating with the mixture, than with sulphate only.

After five or six hours the greater part of the ammonia is distilled; the gas, which is still disengaged, is to be mixed with a quantity of water, more than sufficient to dissolve it completely on coming from the refrigerator. No more bubbles are disengaged in the balloon-receiver.

At this period of the operation the upper part of the washing-bottle becomes filled with white vapours. These vapours proceed from the drying of the contents of the alembic, and the decomposition of organic matters in the ammoniacal salts. On the appearance of the vapours the receiver must be taken away, and replaced by a smaller one. The product of the distillation becomes milky, and serves for a succeeding operation. The washing bottle, used by M. Frésénius, is of iron; it has a glass tube to indicate the level of the liquid, and at one of its tubulures a glass balloon, which the gas traverses before entering the refrigerator.—*Zeitschrifft für Analytische Chemie*, 1862, p. 186.

TECHNICAL CHEMISTRY.

On Refining Petroleum.

The crude oils may at once be submitted to chemical treatment; but as a general rule, and especially when they are heavy and contain much tar, they should be first distilled. This distillation is made in a common iron still, protected from the action of the fire by fire-brick, which equalizes the heat, consequently, the expansion of the metal, and lessens the risk of fracture.

The charge of oil, prepared as above, may be run into the still and distilled, without the use of steam. But when it has been run off to four-fifths of the whole quantity, or when the part remaining in the still will be a thick pitch when cold, common steam should be gently let into the neck or breast of the still. The steam immediately produces an outward current through the condensing apparatus, and brings over all the remaining part of the oils, leaving a compact coke as the only residuum. Furthermore, it gradually diminishes the heat of the iron, and prevents it from breaking. When the steam is thus let in, the fire is to be removed from beneath the still.

Common steam, under moderate pressure, has been introduced into stills, both above the charge and into it throughout the entire distillation. In the latter instance the steam soon becomes superheated after the lighter oils have been run off. Again, steam previously superheated is driven into the charge during the distillation, and for the distillation of the heavy oils and paraffin this mode has the preference; yet steam is advantageous, however applied. When it is superheated the condensing apparatus should be extensive.

In the first distillation of the crude oils, as they come from the retorts, and in subsequent ones, the oils may be slowly admitted into the stills after it has become sufficiently heated, and the oils begin to flow freely from the worm or condenser. By the adjustment of a cock, a stream of the crude product may be permitted to flow through an iron tube into the still while it is in opera-

tion. The tube should dip beneath the oil in the still, the in-flow of oil into which must not exceed the out-flow from the condenser. A greater amount of heat will be required for this operation than for the common method, as much of it is taken up by the cold oil constantly flowing inward. By this mode, a still working 1000 gallons may be made to run double that quantity without interruption, and steam may be applied in any manner before described.

The first distillate of the crude oil should be separated into two parts, each of which requires somewhat different treatment. The first part is that which distils over from the commencement of the run until the oils in the receiver have a proof of 36° by hydrometer, or a specific gravity of 0·843.

These light hydrocarbons, and the eupion they contain, form the lamp-oil. The quantity produced will depend upon the quality of the coal, or, whence they have been derived. This part of the distillate being pumped from the receiving tank, the remainder, or second part, is allowed to flow on till it assumes a greenish colour at the end of the worm pipe, when steam, if not previously employed, may be let into the still, and continued until the whole distillation is completed, the fire in the furnace beneath the still being withdrawn. A quantity of coke will be found to remain, amounting to ten or fifteen per cent. of the whole charge. When steam is not employed in the residuum, the still must not be run down lower than a thick pitch. Coking in the still without steam is unsafe, and hazardous to the iron.

The first part is then to be placed in an iron cistern, and therein thoroughly agitated from one to two hours, with from four to ten per cent. of sulphuric acid, the object being to bring every particle of the impurities in contact with the acid. The quantity of acid to be used depends upon the character of the oils.

If too much acid is applied, the oils will be partially charred and discoloured; if too little, the impurities will not be oxidated, and the oils will change colour. After the agitation of the oil and acid is completed, the mixture must remain at rest from six to eight hours, when the acid, with the chief part of the impurities, will have settled at the bottom of the vessel. They are then to be drawn off, and the remaining oil to be washed with ten or twenty per cent. of water. The water removes a part of the remaining acid, and carries off the soluble impurities. After the water is withdrawn, the charge is to be agitated two hours with from five to ten per cent., by measure, of a solution of caustic potash, or soda, of specific gravity 1·400—caustic soda is generally preferred. Like the acid, the strength and quantity of the alkali must be varied according to the quality of the oils. After a repose of six hours, or more, the alkali is to be withdrawn from the oil, and further impurities washed out with water. When the water is withdrawn from it, it is to be run into a still for final rectification. During the whole of these operations, the oils and the several washes applied to them are to be kept at a temperature not lower than 90° F. This is done by means of steam coils fixed at the bottoms of the tanks in which the agitations are made. Finally, the oil is to be carefully distilled, with or without steam. A small quantity of the lightest product, or eupion, which comes first from the condensing worm, is usually discoloured, and may therefore be transferred to the succeeding charge.

The last distillation should be made slowly and with care, avoiding all fluctuations produced by an unsteady heat. If desired, the eupion may be taken off at the commencement of the distillation. It should be at proof 60°, or specific gravity, 0·733, or it may be allowed to run in with the lamp-oil. When the distillate has reached proof 40°, or specific gravity 0·819, the remainder is to be transferred to the next charge, or the heavy oil, as being too dense for illuminating purposes. The mixed oils intended for lamps have their disagreeable odour chiefly removed by allowing them to remain in flat open cisterns over weak solutions of the alkalies during a period of some days. Exposure to light also improves their colour. The alkalies employed in the foregoing treatment may be restored and used in subsequent purifications. The oils of the second or heavy part of the first distillate are purified by the same means as described for the lighter oils, except that they require the application of more acid and stronger alkalies. All the oils distilled from them at proof 40° are to be added to the lamp-oils. At the close of each distillation, and as the oils acquire greater density, the colour grows darker and changeable; finally, they are partially charred, and especially when they have been distilled without steam. These dark-coloured oils may always be renovated by the use of acids and alkalies, the permanganates of potash and soda, and, finally, by distillation. The colour of the lamp-oils should not exceed a tinge of greenish yellow, when viewed in a clear glass flask six inches in diameter. If by accident, carelessness, or negligence, the oils treated by the foregoing method should be impure, they must be submitted to washing and re-distillation.—*Philadelphia Coal-Oil Circular.*

PHARMACY, TOXICOLOGY, &c.

On the Medico-legal Detection of Silver, by *M.* J. Nicklès.

M. Nicklès having to determine the nature of some suspected spots on body linen, and having detected the presence of silver, devised the following process, borrowed from the electrotype method, to withdraw the silver, and, in spite of the small quantity operated upon, presented it in a state easy to be recognised.

This process leaves nothing to be desired, either in promptness, simplicity, and still less in precision.

To the matters in which the silver is supposed to exist (being, of course, previously assured of the absence of other metals, as lead, mercury, &c.) add some cyanide of potassium, and plunge into one side of the liquid a well-scoured copper wire attached to the negative pole, and to the other a graphite crayon, closing the extremity of the positive pole of a galvanic pile.

It is essential that a galvanic current should be employed, sufficiently feeble to prevent the disengagement of hydrogen round the copper wire attached to the negative pole; otherwise, the silver deposit does not adhere, and becomes more or less pulverulent.

When the quantity of silver to be discovered is excessively small, the extent of the deposit should be very limited, in order to make it as distinct as possible; in fact, only the end of the copper wire should be immersed.

In operating under favourable circumstances, the salt silvers with the greatest facility. The above process is perfectly well adapted for the extraction of silver from the residuums of this metal.

The silver is reduced to the state of chloride, well washed, and dissolved in cyanide of potassium, before exposure to the action of the pile.—*Journal de Pharmacie et de Chemie.*

INTERNATIONAL EXHIBITION.

CLASS XIII.

Philosophical Instruments, and Processes Depending upon their Use.

(*Continued from page 226.*)

We must speak of the Exhibition in the past tense now, and say that Messrs. Spencer, Browning, and Co., exhibited instruments of various kinds which place them in the front rank of makers. Their barometers, aneroid and standard, were of exceedingly neat construction; and a pocket aneroid, the size of a large watch, would be a useful and interesting companion for a traveller. The large spectroscope shown was excellently made, and will, we venture to say, be found a valuable instrument. It is fitted with small prism or slit to show two spectra superimposed. The body of the instrument moves on a joint, to facilitate celestial observations. A small spectroscope exhibited by the same makers will be found a very useful instrument to students commencing the study of spectrum analysis.

Mr. Highley's collection (2912) included several useful and ingenious novelties, among which we may particularly mention the universal polariscope as an instrument which may prove valuable to many of our readers. It is so constructed as to be available for the table or for lecture-room demonstrations, and may be disposed to serve every purpose for which a polariscope of any kind is used. An improved spectroscope shown is also a very valuable instrument. It has an eccentric adjustment of novel construction, so that it can be used with single or double prisms, liquid or solid, of any substance. In connection with it, too, is a variety of apparatus for showing the different phenomena noticed in observations of the spectra of bodies under different physical conditions, such as a tube divided into compartments for showing that the dark lines increase in number with an increase of the length and temperature of the intercepting vapour; and an apparatus for showing the electric spectra of the elementary bodies in an atmosphere of various gases, and several other things of equal interest, which we have not space to particularise. We may call attention, also, to a universal electro-magnetic apparatus, which appears to us a very useful invention. An oxy-hydrogen gasometer exhibited would prove of value to a lecturer who has to carry about his apparatus. The lantern and other apparatus pack away in the gasometer, which, when unpacked, forms a stand for the lantern. Mr. Highley also exhibited a beautiful series of slides for the magic lantern, all exceedingly well executed, and most of them intended to impress the facts of nature and truths of science on the mind, and so adapted to combine amusement with instruction. There were many other useful and beautiful objects in this collection, and that in Class 29, to which we have before referred, a full description of which our readers will find in a catalogue which Mr. Highley has recently issued.

There were but few other cases in this Class which we need particularise; but as some of our readers may now be engaged in the examination of coal-gas, we may call attention to the articles exhibited by Mr. Sugg. He showed specimens of all the instruments necessary for analytical and photometrical experiments on gas, of neat and even elegant construction, which we can recommend to those of our readers as are interested in such investigations. Evans' photometer is a very conveniently-arranged instrument; and the pressure-gauge, with micrometer adjustment for fixing the rate of consumption, is a useful contrivance. Messrs. Benham and Froud exhibited a modest-looking case of well-made platinum utensils which need no praise.

In the French collection the balances of M. Deleuil deserve particular notice, as having been, perhaps, the finest instruments of the kind in the Exhibition. The large balance, turning to half a milligramme when loaded with ten kilogrammes, is an extraordinary instrument. A very ingenious contrivance for weighing *in vacuo*, or under different pressures, in order to verify standard weights, we can only mention, for a description could not be made intelligible without drawings. Another ingenious contrivance,—a "photometrical balance," with a self-acting hammer, which strikes a bell when a given amount of oil has been consumed, might, perhaps, be modified by Mr. Sugg, so as to serve for our plan of estimating the value of gas by comparing it with candles. A large air-pump, which gives a very perfect vacuum, and Thilorier's apparatus for the solidification of carbonic acid, mounted so as to be easily transported, were other noticeable articles in M. Deleuil's valuable collection. M. Collot's balances, in the construction of which he has made use of aluminium, deserve praise for their delicacy and elegant appearance. Other balances and apparatus were exhibited by MM. Hardy, Taurines, and Duthron, which well merit a word of praise.

In the Belgian collection the balance of M. Sacré, of Brussels, with its ingenious contrivances for altering the centre of gravity, merits especial mention. The arrangement appeared to be a most useful one, and deserves to be copied.

In the Austrian department some heavy-looking but delicate balances were exhibited, and some very fine glass apparatus, which we have already noticed.

The Prussian collection of apparatus was very good, and was deservedly rewarded with a number of prize medals, nearly half the exhibitors receiving these rewards. The glass apparatus of M. Greiner, of Erfurt, was of first-class excellence, as were also the apparatus and utensils of MM. Luhme and Warmbrunn and Co., of Berlin. The balances, with indexes and scales at the ends of the beams, by the former exhibitor, might, perhaps, be worthy of imitation. The instruments of Greiner and Son, of Berlin, were very well made.

The rest of the chemical apparatus exhibited we must dismiss very briefly. In the Swiss collection were some small balances, with long steel beams of considerable delicacy, and apparently very cheap, by Thiemeyer, of St. Gall; and a rough but very useful balance for the heavier work in a laboratory. Neat and delicate assaying balances were also exhibited by Grabhorn and Deschamps, of Geneva.

The Rarer Chemicals.

France.—There were several noticeable collections of chemical products shown by French exhibitors. E. J. Menier (204) displayed a series of organic bodies, made by synthesis. Among them we noticed considerable quantities of propylic alcohol, essential oil of mustard, thiossinnamine and stearine. Fine large, pure-looking crystals of strychnine and brucine in most formidable quantities, with excellent specimens of permanganate of potassium, cafeine, atropine, and very many other rare and interesting substances, besides those already mentioned, made M. Menier's case most instructive and valuable.

J. B. Defay and Co. (201) showed specimens of products from blood; an excellent albumen for dyers and calico-printers, as well as a manure, rich in ammoniacal salts and phosphates.

Maumené and Rogelet (149) exhibited samples of "potassa and its salts obtained from sheep-grease." M. Maumené discovered some time back that cold soft water would extract from sheep's wool a potash-soap, almost free from soda. This soap charred, and the residue lixiviated with water, yields nearly pure carbonate of potassium. M. Maumené's discovery is of very great scientific interest, and seems likely to become of considerable economical importance.

C. Collas and Co. (203), the manufacturers of the benzol, known as "benzine Collas," gave us the opportunity of admiring an extraordinary specimen of nitrobenzol. Supposing it to have been free from any admixture with a colourless oil or spirit, this sample of nitrobenzol must be pronounced the best of all those exhibited. Its colour, even in bulk, was the palest straw-yellow.*

Among the chemical products and dye-stuffs shown by C. Kestner (136), a fine specimen of paratartaric acid was conspicuous.

PROCEEDINGS OF SOCIETIES.

GENERAL COUNCIL OF MEDICAL EDUCATION AND REGISTRATION.

Minutes of Meeting, Tuesday, October 28, 1862.

Mr. Green, President, took the Chair, at one o'clock, p.m.

The Minutes of the last meeting were read and confirmed.

The President made a statement of the object of this meeting of the General Medical Council.

Read—The Resolutions passed by the Executive Committee, on July 11, 1862:—

"That while the Executive Committee earnestly desire to comply with the instructions of the General Medical Council, in reference to the publication of the British Pharmacopœia, there nevertheless appear to be grave reasons for first considering more maturely the expediency of introducing, under the authority of the Medical Council, the proposed changes of the weights used in Pharmacy throughout the Empire.

"That it be accordingly proposed to the Pharmacopœia Committee to re-consider the matter; and that it be suggested that the Astronomer Royal, Sir John Herschel, and Professor Miller, of Cambridge, members of the Committee appointed to superintend the construction of the present National Standards, should be invited by the President to favour the Committee with their opinions on the subject."

Resolutions passed by the Royal College of Physicians, London, on July 12, 1862:—

1. "It having come to the knowledge of this College that, in the new Pharmacopœia intended for publication, under the authority of the General Medical Council, it has been contemplated to introduce a new grain, differing from the standard grain weight of the country, the College is of opinion that, however desirable it may be to substitute the avoirdupois pound for the troy pound, it is *not* desirable to introduce a new grain differing from the standard grain, which has been so long in general use, and is established by Act of Parliament."

2. "That Dr. Burrows, as representative of the College in the General Medical Council, be requested to communicate the resolution to the Executive Committee of the Medical Council."

(Signed) Henry A. Pitman, Registrar.

A letter addressed to Dr. Garrod, Secretary of the Pharmacopœia Committee, by Dr. Christison.

"To Dr. Garrod,
"Secretary of the Pharmacopœia Committee.
"Edinburgh, July 18, 1862.

"Sir,—There has been laid this day before the Edinburgh Branch of the Committee for preparing and publishing the British Pharmacopœia, resolutions of the 11th instant, by the Executive Committee of the General Medical Council, relative to the changes proposed by the Pharmacopœia Committee in the weights of Pharmacy. The Edinburgh Sub-Committee instruct me to transmit to you, as Secretory of the whole Committee, the views which have occurred to them on this subject.

"The Sub-Committee submit, with great deference, that the Executive Committee of the Council appear to them to have gone beyond their province in entertaining criticisms as to the construction of the Pharmacopœia which has been prepared by the Pharmacopœia Committee, and adopted as the British Pharmacopœia by resolution of the General Council itself of May 21, 1862. The duty of the Executive Committee, as this Sub-Committee understands the powers delegated by the Minute of Council of the same date, is limited to taking all such steps as may be necessary for the publication of the British Pharmacopœia, and does not extend to controlling the Pharmacopœia Committee in the construction of it, or to altering the Pharmacopœia, which has been sanctioned by the General Council. Had the Executive Committee, therefore, simply remitted the letters of Dr. Paget and Mr. De Morgan to the Pharmacopœia Committee, they would have done, as this Sub-Committee think, all they could correctly do with the subject of these letters, and such an answer would have been given by the Pharmacopœia Committee as would have probably been satisfactory to all parties.

"With this preface, the Sub-Committee beg to remind their brethren of the conjunct Committee that the proposed change in the Pharmacopœia weights was carefully considered by three Sub-Committees, each consisting of five members, at least, and in each of which the three branches of medicine—physic, surgery, and pharmacy—were represented; that it was subsequently considered at a conference of three delegates from each Sub-Committee in May, 1859; that at first prejudices were naturally found to exist against the change; that the same objections now urged by Dr. Paget were at that time brought forward, with others at least as important; but that, in the end, all the members of the conference agreed that the change should be adopted.

"In the Pharmacopœia Committee there was no want of Members amply competent to deal with the scientific, no less than the practical bearings of the subject, and aware of the importance of not losing sight of science while dealing with practice. This Sub-Committee, therefore, do not see the necessity or the propriety of appealing to the opinions of the scientific gentlemen whom the Executive Committee suggest as persons to whom the subject should be referred. The Sub-Committee have, one and all, the highest respect for the eminent men of science who have been named, but they submit, that, as to a question of mingled science and practice, and one much more of practice than of science, the Pharmacopœia Committee do not need refer to any scientific men; and that if they are not themselves more competent to settle such a question than any mere scientific committee, they ought never to

* M. Collas stated, on a conspicuous placard in his case, that he is the discoverer of nitrobenzol, assigning October, 1848, as the date of his discovery. The fact is, that Mitscherlich discovered it thirteen years earlier.

have been appointed, as assuredly they never would have consented to undertake the duty entrusted to them.

"The objectors to the proposed changes in Pharmaceutic weights appear to have lost sight of the fact, that the Pharmacopœia Committee had to deal—1. With an already-existing serious, and practically inconvenient, deviation of the weights and measures of Pharmacy from those of the Imperial standard; 2. With a difference between the Pharmaceutic weights of the three existing Pharmacopœias of the United Kingdom; 3. With a want of conformity between the weights and the measures in each of the three Pharmacopœias; and, 4. With the long-established adoption in Pharmacy of a fluid-grain (minim) differing from the weight-grain, but exactly corresponding with the new Pharmaceutic grain.

"All these discordances the Committee, after long and careful consideration, saw that they could easily remove, so far as practice was concerned, without injury, and with no more than a merely temporary inconvenience, by the slight and simple alteration which has been adopted. In particular, while they have established a slight difference between Pharmacy and other trades in the value of the grain, they have introduced for the first time a conformity in that of the ounce and pound. This must be admitted to be an important object, because the pound and ounce are much in use in the various trades which come in contact with that of Pharmacy; but, on the other hand, as the grain is very little used in the relations existing between Pharmacy and other trades, a slight alteration in its Pharmaceutic value cannot occasion serious inconvenience.

"The Edinburgh Sub-Committee beg to repeat, in terms of the Report of the united Committee, which was adopted by the General Medical Council on the 21st of last May, that in the new Pharmacopœia care has been taken to alter the formulæ of the old Pharmacopœias, so that the doses of active substances shall not be altered, so far as the change in Pharmaceutic weights is concerned. They are further satisfied, that any accidental error, during the period of passage from the old to the new grain, will not be of the slightest signification, as to the action of even the most powerful remedies. And they have to add, that they have received the testimony of the ablest judges in the department of Pharmacy, that the proposed system of Pharmaceutic weights and measures, including the change of value of the grain, will be found very soon to be a great benefit to the Pharmaceutic Chemist.

"With these advantages in prospect, the Edinburgh Sub-Committee are not deterred by the objection, that science will be slighted by the proposed change. They are inclined to think that science has really little to boast of hitherto in the organisation of Imperial weights and measures of the United Kingdom, and very little to suffer through any partial deviation from them. At any rate, they are unable to see how the change in value of the grain in the trade of Pharmacy disregards or injures science in any respect.

"In point of fact, the Pharmacopœia Committee did not adopt the system of weights and measures, which has since received also the sanction of the General Medical Council, without having seriously considered the propriety of throwing aside the Imperial system altogether, and introducing a really scientific one—a decimal system. Two courses were open to them:—either to follow some Continental countries, which have adopted the French metrical system, or to create one more consonant with British ideas, and practically more convenient, by arbitrarily erecting, as Dr. Paget has since proposed, a simple decimal system, founded on the Imperial grain as unit. But the Committee came to the conclusion that either of these changes would be too wide a deviation from the general system of weights and measures of the country, for the General Medical Council to be the first to introduce them; 'and on the whole, that the Legislature, and not the Council, should take the lead in this matter.'—(*Pharmacopœia Report of the General Medical Council*, May 21, 1862.)

"The Edinburgh Sub-Committee will hail with pleasure the occasion when men of science will persuade trade, commerce, and Government that a decimal system of weights and measures is the most truly scientific of all, as well as the most facile in practice. So far as Pharmacy and Medical practice are concerned, men of science will meet with no opposition to a really scientific system, such as that; and no new obstacle will be created by the system which has been adopted in the meantime for Pharmacy by the Pharmacopœia Committee and the General Medical Council, as the only eligible mode of reconciling real existing discrepancies, and getting rid of actual serious inconvenience.

"I am, your most obedient Servant,
"R. Christison."

Resolution of the Dublin Pharmacopœia Sub-Committee:—"That this Sub-Committee fully agrees in opinion with the Edinburgh Sub-Committee, that the Executive Committee of the General Medical Council has exceeded the powers entrusted to it by the General Medical Council, in passing the Resolutions relative to the proposed change in the weights in the British Pharmacopœia, on the 11th of July, 1862, and that this Committee fully adopts the letter of Dr. Christison to Dr. Garrod, of the 18th of July, 1862, which has this day been laid before the Sub-Committee."

Resolution of the London Pharmacopœia Sub-Committee, August 14, 1862, on the Resolution of the Executive Committee of the General Medical Council, July 11, 1862:—"The London Branch Pharmacopœia Committee is of opinion, that as the manuscript of the British Pharmacopœia, with the proposed weights and measures, has already received the sanction of the General Medical Council, it is not at liberty to re-consider the question of the weights, for the purpose of making any fundamental alterations therein, unless empowered to do so by the General Council."

Resolutions of the London Pharmacopœia Sub-Committee on the subject of weights and measures, October 25, 1862:—

1. "The London Sub-Committee is willing to relinquish the new (proposed) grain.

2. "The London Sub-Committee thinks it premature to adopt the metrical system of weights and measures, as it has not yet been sanctioned by the Legislature.

3. "As some decimal system will probably ere long be adopted by the Legislature, the London Sub-Committee does not think it advisable to introduce any new system of weights and measures at the present time.

4. "Considering that two of the three National Pharmacopœias employ the apothecaries' (troy) weight, the London Sub-Committee is of opinion that that system should be ordered to be used in the British Pharmacopœia.

5. "The alteration of the weights from the avoirdupois to the apothecaries' weights will of necessity involve a very extensive revision of the manuscript of the British Pharmacopœia."

1. Moved by Mr. Teale, and seconded by Mr. Syme—"That so much of the Report of the Pharmacopœia Committee, which was presented to the General Council on May 14, 1862, as relates to the system of weights and measures, be re-considered."—Agreed to.

2. Moved by Dr. Sharpey, and seconded by Dr. Storrar—"That the grain weight heretofore in use be adopted in the British Pharmacopœia."

Amendment moved by Dr. Christison, and seconded by Dr. Alexander Wood—"That the Council adopt the French decimal system of weights and measures as the

basis for the standards of weights and measures of the British Pharmacopœia."—Amendment negatived.

The original motion was then put and carried.

The meeting having been adjourned, was resumed at 7 p.m.

3. Moved by Dr. Storrar, and seconded by Dr. Corrigan—"That the weights used in the British Pharmacopœia be the imperial or avoirdupois pound, ounce, and grain; and that the terms 'drachm' and 'scruple,' as designating specific weights, be discontinued."

Amendment moved by Dr. Acland, and seconded by Dr. Stokes—"That all weights below the avoirdupois pound, excepting grains, or multiples, or parts of grains, be omitted from the British Pharmacopœia, whereby the grain weights in use may be uniformly divided or multiplied, duodecimally or decimally, and the inconvenient division of the avoirdupois ounce into 437·5 grains and its subdivisions will be avoided."—Amendment negatived.

The original motion was then put and carried.

4. Moved by Dr. Andrew Wood, and seconded by Mr. Syme—"That it be referred to the Executive Committee, in conjunction with a Committee consisting of one member elected by each branch of the Pharmacopœia Committee, together with Dr. Garrod, the Secretary of the Pharmacopœia, to carry out forthwith the printing and publishing of the British Pharmacopœia."

Amendment moved by Mr. Arnott, and seconded by Dr. Alexander Wood—"That it be remitted to the Pharmacopœia Committee to proceed with the preparation of the Pharmacopœia, in conformity with the resolutions of the Council of this day's date, relative to Pharmaceutic weights." "That the editing of the Pharmacopœia be committed to one member elected by each Sub-Committee." "That the publication and sale of the Pharmacopœia be transferred to the Executive Committee."—The amendment was carried.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 7, 1862.

E. W. Binney, *F.R.S., F.G.S., President, in the Chair.*

A paper, by Robert Rawson, Esq., Hon. Mem., was read, entitled, "*Memoir of the late Professor E. Hodgkinson. Part 2nd.*"

Ordinary Meeting, October 21, 1862.

E. W. Binney, *F.R.S., F.G.S., President, in the Chair.*

The Rev. W. N. Molesworth introduced to the Society M. Jules Gérard, the celebrated African traveller and lion hunter, officer of the French Army in Africa.

M. Gerard delivered an address on Africa, in reference to its future relations with Europe, and on the journey of exploration which he proposes to undertake in the former continent.

The following is a translation by the Rev. W. N. Molesworth, from a summary made by M. Gérard, who spoke in the French language.

M. Gérard discussed—1st, the question of climate; 2nd, that of the races of men by whom the African continent is peopled; 3rd, the means by which he hopes to avoid the difficulties and the dangers which have led to the failure or the death of many previous explorers. M. Gérard observed that Africa is unhealthy only on the southern, eastern, and western coasts in the neighbourhood of the equator; but he maintained that in other latitudes, and especially in the interior, the country is healthy and very habitable for Europeans; and in proof of this he referred to the English colony at the Cape of Good Hope, at the southern extremity of the continent; to Algeria, at the northern extremity; and to all the countries in the centre which are situated at a distance from the great lakes and from the rivers which overflow their banks, that is to say, all the countries which are at a sufficient elevation above the level of the sea, and remote from the miasma produced by stagnant water.

With regard to races, M. Gérard has found that there exist various peoples who are both morally and physically degraded; but he has also found that Africa contains populations which are deserving of interest, and which are susceptible of progress and civilisation. With regard to the former, he expressed his regret at the utter neglect with which they are treated, inasmuch as the more weak and ignorant a being is, the greater is its claim on the indulgence and support of the strong; and he called the attention of the Society to the people of Dahomey, stating that their barbarous customs have not originated with themselves, but from the sovereign and his favourites. As a proof of this assertion M. Gérard said that the victims in their human sacrifices are sometimes prisoners of war, but more frequently men, women, and children belonging to the nation of Dahomey. It is incredible that it can be agreeable or even indifferent to the people of Dahomey to sacrifice their families to the pleasure of the king. M. Gérard is of opinion that the people endure this calamity because imposed on them by despotic violence; but that, however brutalised, they would bless the hands that would bring them deliverance. As a means of promoting a result so desirable in the interests of humanity, M. Gérard proposes to arm the people who dwell on the northern borders of the country of Dahomey. They are the natural enemies of the abominable government of Dahomey for many reasons, of which the principal are, that the troops of the king make continual incursions into their territories to procure slaves, and that he prevents them from trading with the European establishments on the coast. The king of Dahomey closes all the routes in order to prevent these peoples from obtaining any other arms than the primitive ones which they use at present, viz., the lance and the arrow, thus enabling him to preserve the advantages he possesses over them in consequence of the supply of fire-arms which he can command. M. Gérard pointed out that arms and ammunition might be distributed among these peoples by two channels over which the King of Dahomy has no command. With these arms we might introduce men to instruct and direct the natives. This done, the interests of the people of Dahomey would have to be separated from the interests of the dynasty, by means of agents recruited in the country, and thus the axe would be laid to the very root of this dynasty. Then the abominations which have made us groan with horror will be succeeded by a natural state of things; the labours of peace will take the place of war, carnage and fire; and Europe, as well as Africa, will profit by the happy change. In the journey of exploration which he is going to undertake, M. Gérard proposes to study on the spot this great question, in the solution of which he will be happy to participate actively. His point of departure will be Sierra Leone, or some other English possession a little further to the west. He will endeavour, first, to discover the sources of the Niger, which are still unknown. Afterwards he will visit the peoples who dwell at the northern extremity of the republic of Liberia and the country of Dahomey. He will then return towards the upper basin of the great river, where, according to the information he has obtained, he expects to find a vast agricultural country in which the natives produce cotton and indigo; and in which he hopes that an establishment may be founded for encouraging the growth of these productions, and extending commercial relations with Europe. After having studied these countries and their inhabitants, M. Gérard will visit Timbuctoo, in order to obtain the papers of the unfortunate Major Laing, who was murdered near this town in 1822. From Timbuctoo he will return to Europe by Ainselah, Goleah, and Algiers. The length of this journey is about three thousand miles: for the purpose of accomplishing it M. Gérard reckons on

the destruction which he will make of leopards, lions, and panthers, which depopulate whole villages in these countries; and on the relations he has formed with the Arabs. M. Gérard concluded by thanking the president and the members of the Society for the great attention with which he had been heard, although addressing them in a foreign language.

A vote of thanks to M. Gérard having been passed, and some discussion having taken place on his paper—

The Rev. W. N. Molesworth remarked that M. Gérard had visited Manchester in the hope of obtaining pecuniary assistance towards carrying out his proposed explorations. His object was of great importance both in a scientific and commercial point of view. He was opening up to them new sources whence they might be supplied with good and cheap cotton, and he also expected to make geographical, ethnological, and zoological discoveries. It was to be hoped, therefore, that gentlemen present who felt an interest in either of these two objects would make his purpose as widely known as possible, and render to him, or obtain for him all the assistance they could.

Some remarks having been made respecting the sudden fall of the barometer, which occurred on Sunday, the 19th inst., Mr. Baxendell read the following extract of a letter from Mr. Vernon, F.R.A.S.:—"At 8h. a.m. on Sunday, the reading of the barometer was 29·483 inches, and at 9h. 50m. p.m. 28·502 inches, a fall of 0·981 inches in a little over twelve hours: the entire fall in ten days was 1·8 inches, a very unusual amount. The depression accompanying the Royal Charter storm was only about one-half that accompanying the past storm."

Mr. Alfred Fryer, who observed the movements of an aneroid barometer under the microscope during the storm, stated that the minimum pressure occurred at 10h. 10m. p.m., and that for some minutes before and after this time the index of the instrument was in a state of rapid vibration.

A paper was read by Dr. J. P. Joule, entitled, "*Notice of a Compressing Air Pump.*"

The author referred to the difficulties of realising in practice the theoretical advantages of the air, or the superheated steam-engine. The abrasion which takes place when metal rubs against metal, without an intermediate lubricator, speedily destroys the cylinder. He believed that the necessity of using elastic packing would not exist if the length of the channel along which the elastic fluid must pass, in order to arrive at the opposite side of the cylinder, were sufficiently increased. This might be accomplished by increasing the depth of the piston, or by placing on the rim of the piston concentric rings to enter, at the beginning and end of each stroke, corresponding concentric grooves in the covers of the cylinder.

The principle of great depth of piston, as a substitute for packing, had been successfully carried out in the pump which was the subject of this communication. The cylinders, two in number, are twenty inches long and two inches in diameter. The pistons are solid cylinders of iron, ten inches long, fitting as accurately to the cylinders as is consistent with freedom of motion. The depth of each piston, as compared with its diameter, renders the usual guide or parallel motion unnecessary, so that the connecting rod is simply jointed to the top of the piston. Air is readily compressed to sixteen atmospheres, the quantity passing the sides of the cylinders being very trifling.

MICROSCOPICAL SECTION.

Fourth Annual Meeting, May 19, 1862.

E. W. Binney, *F.R.S., F.G.S., V.P. of the Section, in the Chair.*

Mr. David Joy, and Mr. John Leigh, M.R.C.S., were elected members of the Section.

The Secretary then read the Annual Report of the Council, which was agreed to, and ordered to be printed for circulation amongst the members.

The following gentlemen were then elected officers for the ensuing Session:—President, William C. Williamson, F.R.S.; Vice-Presidents, Edward W. Binney, F.R.S., F.G.S., Joseph Sidebotham, Arthur G. Latham; Secretary, George Mosley; Treasurer, James G. Lynde, M. Inst. C.E., F.G.S. Of the Council, Thomas Alcock, M.D., Joseph Baxendell, F.R.A.S., John Dale, F.C.S., J. W. Maclure, F.R.G.S., Thomas H. Nevill, John Parry, William Roberts, M.D., John Watson.

It was proposed by Mr. Lynde, seconded by Mr. Nevill, and carried unanimously, that the following alterations be made in the Rules:—

No person shall be eligible for the office of President for more than two years in succession.

The Vice-President who has attended the least number of meetings shall be ineligible for re-election as Vice-President for at least one year.

The two members of the Council who have attended the least number of meetings shall be ineligible for re-election for at least one year.

October 20, 1862.

Professor Williamson, *F.R.S., President of the Section, in the Chair.*

Mr. George Venables Vernon, F.R.A.S., was elected a member of the Section.

Mrs. Bury, of Croft Lodge, Ambleside, presented, through Professor Williamson, a series of twelve photographic plates, with seventy-two figures of *Polycistins*, from drawings by that lady; also seventeen mounted slides of Barbadoes earth.

Mr. Horatio J. Frembly, of Gibraltar, presented, through Mr. H. A. Hurst, thirty-four slides of tongues of mollusca, collected and mounted by himself. An elaborate report upon their scientific classification was read by Dr. Thomas Alcock.

Mr. H. A. Hurst presented a collection of tongues of mollusca, from Bengal, made by him during his residence in India. They have been placed in the hands of Dr. Alcock, who has kindly undertaken to examine and report thereupon.

Captain J. C. Gales, of the ship *Quito*, presented soundings taken off the coast of Chili and the Falkland Islands; two specimens of anchor mud, from the Falkland Islands; and some of the *Fucus Natans* from the Sargossa Sea, with specimens of its inhabitants, dried in the sun. Captain Curling, of the P. and O S.S. *China*, presented four soundings from the coasts of Malabar, Yemen, Malacca, &c.; Captain Vickers, of the *Rosina Claypole*, anchor mud from Port Royal and Black River, Jamaica, and a sounding taken off the south coast of Ireland; and Captain Samuel Flood, of the ship *Pantoleon*, anchor mud from Sumatra and Malacca. Two deep Atlantic soundings in 1730 and 2220 fathoms, were also thankfully acknowledged.

Mr. Thomas Heelis presented many interesting specimens, collected during his late voyage, amongst which may be named two soundings from the Agulhas Bank, two specimens of Hooghly mud, scales of flying fish, and Gulf weed, with minute crustacea and other animals preserved in spirits.

Mr. Joseph Sidebotham presented to every member of the Section a photographed finder for high powers, in case inscribed with the member's name.

Mr. John Dale presented a quantity of dessicated balsam dissolved in chloroform, to be divided amongst the members.

Mr. A. G. Latham presented a mounted spiracle of a mole cricket from Africa, and pointed out the difference from that found in this country.

Mr. E. W. Binney presented a copy of his paper "*On*

some Fossil Plants showing Structure, from the Lower Coal Measures of Lancashire."

A letter was read from Mr. Thomas D. Toase, of Jamaica, with reference to the animalcule previously described.

Mr. Brothers exhibited some fine specimens of *Stephanoceros.*

Mr. Parry exhibited some photographs of magnified sections of wood.

Mr. W. H. Heys exhibited the peculiar oil glands on the leaf of the *Procranthera Violacea;* stellate hairs on the calyx of the *Deutzia Scabra,* which differ from those on the leaves by having a greater number of rays and a central disc; spines of the *Loasa Coccinea;* and two kinds of spangles upon oak leaves from Beddgelert.

Dr. William Roberts exhibited a mounted specimen of crystals of *Cystin.*

NOTICES OF BOOKS.

Phosphorescence; or, the Emission of Light by Minerals, Plants, and Animals. By T. L. Phipson, Ph.D., F.C.S., Member of the Chemical Society of Paris, &c. London: 1862.

Phosphorescence is certainly one of the most interesting subjects that present themselves to the physicist or the chemist. It is not surprising, therefore, that Dr. Phipson should have laboured long and widely in this field, for it is almost certain that researches upon a subject so little known, and which has hitherto been studied only in some of its details, must meet with their reward, and open new paths in science. The author has already published several short papers upon phosphoric phenomena; but in the present curious and interesting volume he has brought forward not only the results of his own researches, but everything that he has been able to glean from other sources concerning phenomena of phosphorescence.

The reason why many phosphoric phenomena, though they cannot be looked upon as of rare occurrence, have hitherto escaped the observation of most people, is obvious from the fact, that we are in the habit of closing our eyes as night approaches. And the wonder is how, under such circumstances, so many chemical substances which emit light have been discovered. A person who has once shaken up, in the dark, a glass bottle containing about a pound of nitrate of uranium, for instance, and witnessed the magnificent phosphorescence thus produced, is not likely ever to forget it. Indeed, there is something exceedingly beautiful in this spontaneous emission of light by various matters; and whether we witness the phosphorescence of a mineral, a fungus, a firefly, or a polype, —whether we find ourselves accidentally in a self-luminous mist, or witness the phosphorescence of the snow beneath our feet, our attention becomes riveted in an unusual manner to these light-emitting objects.

In the volume before us the author has had to contend with a serious difficulty. He has endeavoured to render it interesting, not only to those whose lives are devoted to physical and chemical research, but also to that class of society which the French designate as *gens du monde.* Hence, an almost romantic introduction treating of the discovery of solar phosphorus by the cobbler of Bologna, and that of the element phosphorus by the alchemist, Brandt, which forms, however, an excellent prelude to the work. Hence, also, a number of very good wood-cuts of minerals, plants, and animals endowed with extraordinary phosphoric properties, which are dispersed throughout the text.

The scientific portion of the work is divided into four parts, the first of which treats of the phosphorescence of mineral substances, the second of vegetable phosphorescence, and the third of phosphorescence in animals; the fourth division is devoted to history, theory, and practical considerations. In the first part we have, also, a long chapter upon some very curious cases of meteorological phosphorescence, together with considerations upon the phosphoric light of the moon, of Venus, and other planets; and at the end of the volume we have an Appendix (by no means the least interesting portion), containing a list of the principal works which have contributed to our present knowledge of phosphorescence, from the treatise of Fabricio of Aquapendente, in the sixteenth century, down to the most recent researches of the present day, most of which are analysed in a few phrases. We regret that the author has omitted in this list the name of Dr. Pring, whose excellent researches on the light of the *Noctiluca* preceded those of Quatrefages and Verhaeghe, quoted in the text.

Although people who really enjoy the beauties of nature are apt to pay little attention to practical details, yet Dr. Phipson has thought proper to show that phosphorescence is far from being devoid of utility. He has proved, for instance, that the oxy hydrogen or lime light, which is, without exception, the most brilliant light man has ever produced, is a phosphoric luminosity. "If a piece of borax," says our author, "be heated before the blowpipe, it melts when it has attained a red heat. If it be now allowed to cool, and a little lime sprinkled over it, on applying heat a second time, the lime becomes vividly phosphorescent long before the borax is at all affected by the heat. It is, therefore, evident that lime glows vividly with phosphoric light, long before its temperature has attained what is termed a red-heat."

As concerns the phosphorescence of mineral and chemical substances, we find this phenomenon induced by insolution, or exposure to the sun, by heat, friction, cleavage, crystallisation, percussion, molecular or chemical change, and by electricity. It is the so-called actinic or chemical rays which excite phosphorescence by insolation; the red rays of the other extremity of the spectrum often extinguishing the light produced by the violet end. These are precisely the rays which cause chlorine and hydrogen to combine, and which accomplish the wonderful change upon the photographer's paper. Referring again to this remarkable case of phosphorescence in the theoretical portion of his work, Dr. Phipson says:—

"My own idea of phosphorescence after insolation is as follows:—The light of the sun, acting upon a mineral substance, occasions a certain vibration (electric, chemical, or magnetic); but this vibration not being able to continue when the action of light ceases, that is, when the substance is placed in obscurity, the body gives back light whilst losing the vibration (electric, chemical, or magnetic) occasioned in it by the rays of the sun. *The body in question does not, in this case, give back the entire quantity of light it has received, but a quantity equivalent to the electric, chemical, or magnetic vibration induced in it by the direct influence of the solar light.*" The author goes on to show that a magnetic vibration is probably commonest, alluding to some curious experiments made by Grove in 1845.

It is evident that a similar conception would apply to phosphorescence by heat, chemical action, electricity, &c. Many cases of phosphorescence are closely allied to electricity, for we find that bodies, which are *bad conductors,* are very apt to become phosphorescent, whilst those which are good conductors rarely or ever manifest the phenomenon.

The following is a list of the more important phosphorescent substances treated of in the first part of the work before us:—Fluorspar, apatite, blende, feldspar, wollastonite, calamine, chalkosine, oxide of zinc, lepidolite, samarskite, gadolinite, mica, quartz, amber, boracic acid, chlorate of potash, phosphate of lead, phosphorus, sulphur, sodium, potassium, arsenic, tellurium, stibine, hypophosphites of soda and lime, sulphate of potash and soda, arsenious acid, nitrate of uranium, calomel, titanic and

tantalic acids, sugar, mannite, lactine, valerate of quinine, sulphate of quinine, cinchonine, oxides of zirconium, chromium, iron, &c., sulphides of barium, strontium, calcium, diamond, lime, potash, soda, magnesia, oxide of molybdenum, vanadic acid, antimoniate of copper, phosphate of magnesia, phosphoretted hydrogen, oxygen, sulphurous acid, alcoholic vapours, vapours of turpentine, vapours of bichloride of tin, platinum, paper, teeth, ice and snow, water (whilst freezing), water (as vapour), &c., &c.

All these substances have been seen to become luminous in the divers circumstances alluded to above.

With regard to that myterious phenomenon known as the *Will-o'-the-Wisp*, Dr. Phipson, after discussing the various theories brought forward to explain it, shows that several distinct phenomena appear to have been classed under this name; but as regards our English *Will-o'-the-Wisp*, which flickers over boggy lands, it is evidently nothing more than ignited marsh-gas (carburetted hydrogen), the same gas which spontaneously inflames in coal mines, the specific gravity of which is about one-half that of air. Its faint flame is always invisible in the daytime, but becomes visible as night approaches, burning very wildly from the lightness of the gas. Some years ago, Mr. Blesson succeeded in lighting a piece of paper by the flame of a *Will-o'-the-Wisp*.

We cannot follow the author in his investigation of the various meteorological productions of light, in those curious cases of emission of light by nasturtiums, lilies, poppies, &c., and among the host of animal organisms endowed with phosphoric properties. The author has given the name of *subjective phosphorescence* to the light which is emitted when the optic nerve is injured by a wound, by electricity, by the use of narcotic medicines, &c. "A production of light in the above circumstances," says Dr. Phipson, "is exceedingly interesting, and tends, perhaps, more than we are aware, to establish the fact, that the phenomena of light are owing to a *vibratory movement of matter*."

Indeed, the volume which we have so imperfectly noticed cannot fail to have a marked influence upon the study of light, and as such we heartily recommend it to all inquiring minds. We will only add that it has been brought out with the usual care and elegance which characterises most of Mr. Lovell Reeve's scientific publications.

NOTICES OF PATENTS.

2162. *Starch.* J. S. Matthews, Moore Cottage, Bowling Green Street, Kennington Park. Dated Aug. 30, 1861.

This invention relates, in the first place, to the preparation and manufacture of starch and starchy matters from roots, cereals, and grain commonly employed for such purposes, as potatoes, wheat, rice, oats, maize, and sago, either in the whole or ground state. Also from other roots, grain, lichens, and algæ not hitherto employed for such purposes, as Jerusalem artichokes, mangold-worzell, parsnips, broad beans, peas, haricots, lentils, hyacinth bulbs, carrageen moss, cetruria islandica, chonrous crispus, &c. The second division relates to the admixture and combination of the different starches produced from the foregoing substances in such proportions as will best suit the purposes for which the starch is intended to be used. The third division relates to the employment of various anti-combustible materials in the preparation of the starch, which shall render it non-inflammable in its use with all kinds of fabrics, even those of the finest texture—such composition being varied to suit the purpose for which the starch is required to be used.

The last part of this specification is untenable, from the circumstance that Messrs. Versmann and Oppenheim have, in an earlier patent, claimed the employment of starch in conjunction with anti-combustible materials.

2196. *Improvements in Treating Yeast, and in the Manufacture of Ammoniacal Salts, and a Substitute for Animal Charcoal.* Patrick Robertson, Sun Court, Cornhill, London. Dated September 3, 1861. (Not proceeded with)

In order to obtain yeast in a condition in which it may be kept for a considerable time without prejudice to its quality, the inventor first separates from it as much of the moisture as possible, by subjecting the yeast to the action of a centrifugal machine, or to pressure in any way, and then finally dries it in a desiccating chamber having shelves, upon which are placed trays containing sulphuric acid, chloride of calcium, lime, or carbonate of potash; at the same time a partial vacuum is maintained by an exhausting pump until the yeast is completely dried. When reduced to powder it is fit for use, and should be stored in carefully-closed vessels. For the preparation of a substitute for animal black, the moist yeast is mixed with clay and chalk, dried, and subjected to heat in a crucible or retort, the latter being preferred, inasmuch as it permits of the collection of the ammoniacal products, &c. This mixture should be made in such proportions, that the product may contain about 10 parts of carbon, 80 parts of clay, and 10 of chalk; but when it is intended to be employed in association with acids, the chalk must be left out of the composition, and only yeast and clay employed. During the action of heat upon the above mixtures a certain quantity of water, carbonate of ammonia, oil, and gases are evolved; all but the last are condensed in a suitable receiver, the oil floating upon the top, and the carbonate of ammonia being dissolved in the water. This aqueous solution may then by the ordinary processes be transformed into muriate or sulphate of ammonia.

2233. *Substitute for Gunpowder.* T. S. Yates and E. Harrison, Oldham. Dated September 6, 1861. (Not proceeded with.)

The composition, recommended to be used as a substitute for gunpowder, is a mixture of the following ingredients in 100 parts by weight :—

Chlorate of potash	56 parts.
Yellow prussiate of potash	28 ,,
Sulphur	7 ,,
Charcoal	5 ,,
Starch (from potato)	4 ,,

The five parts of charcoal may be replaced by half that amount of cannel coal, or, in certain cases, by anthracite. The admixture of a small proportion of phosphorus confers more highly explosive properties, and the use of red prussiate of potash instead of the yellow salt is sometimes advantageous.

The suggestion here described is far from being a novelty. Compositions very similar in their character to the above have, on several occasions, been noticed in our pages; they all appear to be based upon the instructions given by Augendre in 1850* for the manufacture of an explosive material named by him "white gunpowder," and which was prepared from,—

Chlorate of potash	2 parts.
Yellow prussiate of potash	1 ,,
Refined sugar	2 ,,

These ingredients, being separately reduced to the state of fine powder, were then intimately mixed. The composition was said to be more powerful in its action than ordinary gunpowder, and the inventor advocated its employment on the ground of greater security, inasmuch as the three constituents might be stored separately, and only mixed when required.

* Chemical Gazette for that year, page 198.

Besides being very expensive, the mixture recently suggested would be highly dangerous, from its containing so large an amount of sulphur or even phosphorus, which in the presence of the chlorate would confer detonating properties.

2238. *Making Potash, Pearlash, and Caustic Potash of Commerce.* N. D. P. Maillard, Dublin. Dated September 7, 1861.

This invention relates to the extraction of potash from the ashes of peat or bog earth, which the patentee carries out in the following manner:—

He constructs a furnace of suitable dimensions and simple form over an ash-pit, covered with a movable wire screen to keep back the larger cinders which fall through the bars of the fire-grate; having lighted a brisk fire, the peat or turf is thrown upon the top of the fuel, and either allowed to smoulder in an ordinary current of air, or the process may be expedited by the action of a blast driven by a fan or other arrangement fixed outside the furnace: in either case the ashes fall through the lower bars, and are driven through certain lateral apertures, and collect in receptacles, from which it is taken periodically, and lixiviated to furnish the potash of commerce.

In the case of an article so abundant as Irish peat, it is possible to conceive that the extraction of potash may be conducted with profit, especially at the present time, by a process which gives no other than this one product. It would be desirable, however, to carry out the object of this patent in conjunction with a preliminary distillation of the peat, so that the volatile products may be collected at the same time that the ashes are economised.

Notices to Proceed.

1875. Thomas Rainforth Tebbutt, Manchester, "Certain improvements in the manufacture of soap, soda, and other material employed for the purpose of washing and cleansing."—Petition recorded June 26, 1862.

1919. George Henry Birkbeck, Southampton-buildings, Chancery-lane, London, "Improvements in processes for the utilisation of certain refuse products resulting from the manufacture of iron, such processes being applicable to the treatment of other metallic or mineral substances."—A communication from Emmanuel Minary and Raymond Soudry, Paris.—Petition recorded July 1, 1862.

CORRESPONDENCE.

Balloon Navigation.

To the Editor of the Chemical News.

Sir,—When I wrote to you the few hints on the subject of "Balloon Navigation," I had never read, or even so much as heard of, Edgar Poe's brilliant speculations in the same direction, otherwise I would have mentioned his priority in suggesting the use of compressed air for the purpose in question.

There is, however, a wide difference between the publication of an idea in a thoroughly useless and impracticable shape, merely intended as a clever squib, with the express view of indulging in ridicule at the expense of science, and the rendering of a similar idea into a practical form, in which it is available for effecting a desired object,—an object, be it observed, not by any means of an impossible or chimerical character, but one which has been considered worthy of, and has received, the attention of several men well known in the scientific world.

It is hardly necessary for me to add, that no thinking mind will reject a suggestion of a sound and sober description, well calculated to effect a specific purpose and thoroughly in accordance with known natural laws, simply on the ground of a similar idea having been described as achieving impossibilities of the most ludicrous character, in such works as "Gulliver's Travels," "Don Quixote," and "Tales of Mystery, Imagination, and Humour."—I am, &c. John Newlands, F.C.S.

Non-inflammable Fabrics.

To the Editor of the Chemical News.

Sir,—We were astonished to read in Dr. Lankester's report the enormous loss of life arising from the ample skirts of the fair sex—viz., 750 annually. It certainly behoves men of science to give their attention to the best way of meeting these awful calamities. Could any of your subscribers tell us of a non-inflammable substance which might be mixed with starch sufficiently cheap to meet the demands of the public? We are aware that several compounds have been employed for this purpose, but either from the high price, corrosive nature of the constituents, deliquescent properties, or large quantities required, are not applicable to all fabrics.—We are, &c.

Maltby Brothers.

Starch and Gum Works.

MISCELLANEOUS.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, November 3, 1862.

William Pole, *Esq., M.A., F.R.S., Treasurer and Vice-President, in the Chair.*

August F. Andresen, Esq.; Thomas R. Williams, Esq.; and the Hon. Wm. Warren Vernon, were elected members of the Royal Institution.

The decease of Sir B. C. Brodie, Bart., Manager of the Royal Institution, was announced.

The following Lecture arrangements have been made for the ensuing season:—

Christmas Lectures, 1862.

Prof. Frankland, F.R.S.—Six Lectures, *On Air and Water.*

(*Adapted to a Juvenile Auditory.*)

Before Easter, 1863.

Prof. J. Marshall, F.R.S.—Twelve Lectures, *On Physiology.*

Prof. E. Frankland, F.R.S.—Ten Lectures, *On Chemistry.*

W. Savory, Esq., F.R.S.—Four Lectures, *On Life and Death.*

Prof. Max Müller.—Twelve Lectures.

After Easter.

Prof. Tnydall, F.R.S.—Seven Lectures.

D. T. Ansted, Esq., F.R.S.—Nine Lectures, *On Geology.*

Prof. William Thomson, F.R.S.—Three Lectures, *On Electric Telegraphy.*

The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

SEWAGE OF TOWNS.

The second report of the Commission appointed to inquire into the best mode of distributing the sewage of towns, and applying it to beneficial and profitable uses, has just been published. Besides much valuable information, the volume contains a series of conclusions, of which the

following are the principal, as the result of the Commission's investigations :—

"That the pollution of the rivers of the country is so great and general as to have become a national evil.

"That this pollution has progressively increased in recent years, is still rapidly increasing, and, unless arrested, must necessarily continue to do so in proportion to the increase of population, the progress of house drainage, and the extension of manufactures.

"That although one of the chief causes of this pollution is the practice of discharging sewage as it comes from towns into the nearest rivers or watercourses, thus converting them into sewers, yet the pollution from this cause is by no means confined to towns which have adopted systematic measures for improved sewerage. Nor is the amount of pollution in proportion exclusively to the completeness of such works; for, in many of the towns in which the bulk of the foul refuse is still retained in cesspools and middens, the neighbouring rivers are in a highly offensive and noxious condition, even where the cesspool system is maintained on the alleged ground of preserving the local rivers from contamination.

"That, besides the pollution of rivers by the discharge of sewage into them, they are in general made the common and ready receptacles of an immense amount of offensive matter from factories, dye-works, gas-works, iron foundries, mills, and other establishments, while cinder-heaps and masses of rubbish of every description that cover their banks, and the large stones and other refuse that obstruct the beds, testify to the general neglect and ill-usage of rivers.

"That by far the greater part of the solid matter which is held in suspension in water is readily deposited in rivers, covering the banks with mud, permanently raising the beds, gradually destroying the scouring power of the water, and partially silting such rivers up, and that in some instances these deposits have accumulated to such an extent as to impede navigation, to render the surrounding country subject to floods, and to entail a vast expense in periodic cleansing.

"That however the appearance of the water may be improved, after these deposits have taken place, yet the deposited matters, lying in the bed of the current, are under conditions favourable for putrefaction. And when the foul mud is disturbed by the prevalence of rain and during floods, it sends forth its effluvia amidst the populations which are near, and even in the course of the rivers far distant.

"That the only radical way of restoring the rivers to their original purity is to prevent the discharge of foul matters into them, and especially the discharge of sewage and other refuse of large towns; but that in various cases where this radical treatment has been deemed inadmissible, expedients for the purpose of depriving sewage of its offensive and noxious properties have been brought into practical operation, and have been attended with more or less success.

"That the value of the solid portions of sewage being small, all attempts at realising profits from its preparation as manure have signally failed, but mixed with sweepings and other dry refuse of towns, a ready sale is found for it at 2s. or 3s. per ton, which is sufficient to pay a large proportion of the necessary working expenses for preventing nuisance. That the cost of the operation has in various instances ranged from ½d. to 3d. per head of the population per annum, including interest on the outlay for works; there can, therefore, be no difficulty on the ground of expense in requiring the adoption of adequate means for a removal of nuisance in every case in which injury or inconvenience is shown to arise.

"That the most beneficial and most profitable method of disposing of sewage, where circumstances will admit of this use of it, is by direct application in the liquid form to land; where such applications can only be conveniently effected near habitations, it may be desirable to employ some deodorising agent, but usually, if proper arrangements are made for conveying sewage on to the land, this expense need not be incurrred.

"There is reason to hope that trials and experiments instituted by the Commission, and still in progress, in relation to the irrigation of land with sewage, will remove some doubts and difficulties which have hitherto prevailed in retarding a more general adoption of this desirable mode of disposing of, and utilising the sewage of towns."

The Commissioners conclude by repeating their conviction, that the only security for a general and continued employment of the means of disposing of the sewage of towns will be the establishment of responsible conservancies throughout the country, armed with adequate powers for preventing damage and for effecting improvements. They believe that these powers would be best vested in independent local authorities, such as the present commissions of sewers, acting under certain Government regulations in respect of borrowing money and other matters; and respectfully but earnestly recommend that such inquiries should be instituted into the various points bearing on the subject, so that measures may be submitted which will enable Parliament to deal with the existing evils in a way most conducive to public interests.

Mistaken Detection of Alum in Bread.—In consequence of some rumours which have reached us, we think it but right to state that the proceedings reported under the above heading in Numbers 150 and 151 of the CHEMICAL NEWS, did not take place in London, and that no London chemist was engaged.

Manufacture of Saltpetre.—Saltpetre is obtained in the Mammoth Cave, Kentucky, and considerable quantities were obtained from this source during the war of 1812. It is derived chiefly from the excrements of bats, &c. Most all the saltpetre which is employed for the manufacture of our gunpowder comes from India. It is not known whether any saltpetre is now obtained from natural sources in the Southern States. If the Secessionists were deprived of this substance entirely, they could not carry on a war. The nitrate of soda is very abundant in many parts of the world, and were it not so deliquescent, it would answer just as well for making gunpowder as nitrate of potash. The formation of natural saltpetre is a very slow process, requiring about two years to complete. During the French Revolution 2000 tons were made in one year in Paris; and were foreign supplies cut off, twice this quantity could be made in the same space of time in the city of New York with its present number of inhabitants. In Sweden, each peasant who owns a house is bound by law to make a certain quantity of saltpetre every year for the use of the State. In Spain, Egypt, Persia, and especially India, vast quantities of this salt are made annually; and it is not only a source of great profit but of warlike power to Great Britain.—*Scientific American.*

ANSWERS TO CORRESPONDENTS.

R. E. B.—Spiegle-glance, probably; but we will examine the specimens more particularly.

G. O.—Aromatic vinegar is made by flavouring glacial acetic acid with various essential oils. Our correspondent may flavour to his taste, and produce something new.

W. B.—Different gums require different treatments. Anime dissolves easily in spirit, but makes a soft, badly-drying varnish. Copal requires to be heated before it will dissolve. In general, the gums must be mixed with sand or powdered glass to prevent their caking, and in some instances they must be heated with the solvent.

G. D. Glasgow.—The formula is obviously bad. You may leave out the sodæ carb. with advantage, and we can see no reason for employing the sulphates of iron and zinc with hydrochloric acid. The others, with a little more oil, will give a good polish, which will not, however stand much wet. For that purpose you must have a real varnish.

THE CHEMICAL NEWS.

VOL. VI. No. 154.—November 15, 1862.

SECRETS FROM THE "BRITISH PHARMACOPŒIA."

WE call attention to the conversation at the last Pharmaceutical meeting, which will be found reported in another place, for the purpose of clearing away some of the mystification in which it was attempted to involve the affair. It is quite true that the "British Pharmacopœia" has not at present an actual existence; it is still, so to speak, in the womb. It is certain, nevertheless, that there are many persons, who have a greater or less acquaintance with the manuscript of this volume; and the only question is, whether such persons do not make an unfair use of their knowledge, when they convert a formula, which is most certainly public property, into a means of advancing the interest of particular establishments? If a Bank Director, knowing that the rate of discount was about to be raised, were to recommend his particular friends to get a good deal of paper done before a certain time; or if a Cabinet Minister were to take advantage of his opportunities for acquiring early information to speculate in the funds, we know very well what the public would say of them. The conduct of those who prescribe *Linimentum Belladonnæ Pharm. Britt.* before the "British Pharmacopœia" is published, and send their patients to a particular shop for the medicine, is of just the same nature. Nor is the matter at all mended if the druggist is the communicator of the information.

In old Rome, we are told, a *medicus* made a compact with an undertaker to kill his patients, and recommend the undertaker, on condition that the latter gave to the *medicus* half the linen furnished by the friends of the deceased for the embalment of the body. Now, we do not say that the relations which in these days sometimes obtain between druggists and medical men are quite so objectionable as the above; but our knowledge of human nature forbids us to believe that they are always of an entirely disinterested character. A *quid pro quo* of some kind must always, we fear, be understood; and if the patient does not suffer in health, it is more than probable that he will in pocket.

But there is another and more public side to the present question, which has hitherto been overlooked. If this belladonna liniment is so excellent a preparation that it must be prescribed at once, why is the advantage of it to be confined to the favoured patients of a few medical men? Why should not every person suffering from pain it is likely to relieve have the benefit of it? By all means, let us have the formula published at once, so that every one who needs it may profit by this valuable remedy.

And, after all, it would appear that the secret has leaked out in a very imperfect form. There are two liniments, it seems, each of which the compounders claim to be of the British Pharmacopœia. One has camphor in it, the other has not. Perhaps there is to be both a simple and a compound belladonna liniment in the new Pharmacopœia. But, whatever there is to be in it, by all means let the book be published at once. Every one interested in the work is waiting for it; and the finances of the Medical Council, we are told, sadly want recruiting. These are abundant reasons for hastening the publication. But, if it must be delayed still longer, and there are those who know the preparations, and wish to prescribe them, it would save some scandal if, until the book is out, they prescribe all the ingredients. It would be very little more trouble to do so; and it would save many ill-natured remarks, our own among them.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Formation of Ammonia by Means of Water and Atmospheric Air, by M. F. C. SCHÖENBEIN.

THE importance of the subject, in an agricultural and industrial sense, has induced us to give a complete analysis of this interesting work.

The author takes, as a starting-point, the observation made by him, about a year ago, on the combustion of phosphorus; he proved, in short, that nitrite of ammonia is formed by the slow combustion of that body.

The constant presence of nitrite of ammonia in rain-water led him to conclude that the formation of this salt was due to yet other causes than to nitrogenised matters under decomposition, or to atmospheric electricity. The following is the first experiment which induced him to study more closely this interesting observation.

A platinum capsule was heated until a drop of water thrown into it was immediately converted into vapour without taking the spheroidal form. Perfectly pure water was used, and dropped so slowly, that one drop had evaporated before the arrival of a second.

Above the capsule was a small inverted vessel in which the vapours were condensed. On examination, the water collected in this way was found to contain an appreciable quantity of nitrite of ammonia; in fact, when acidulated with sulphuric acid, it instantaneously coloured blue starched iodide of potassium. Treated by caustic potash, it threw off white vapours when approached by a rod moistened in hydrochloric acid: turmeric paper placed above the vessel became brown.

Whether platinum, silver, copper, iron, or porcelain capsules were employed, the same result took place.

By using a copper alembic, much larger quantities of the liquid can be prepared. The empty alembic is made sufficiently hot to speedily vaporise the water without its taking the spheroidal shape.

Small quantities of water were successively introduced, one portion being completely evaporated before the addition of another.

The alembic was furnished with a Liebig's condenser, and the condensed liquid collected. A colourless neutral liquid was, in a short time, formed in the receiver, which gave to starched iodide of potassium, with the addition of a little pure sulphuric acid, an intense blue colour, while it decolorised permanganate of potash.*

This solution, decomposed by pure potash and evaporated to dryness, leaves a residue with all the characteristics of nitrite of potash. The solution of nitrite of ammonia cannot be evaporated without volatilising the greater part of this salt. In preparing the above solution, it is difficult to guard against this kind of loss.

When treated by sulphuric acid, this nitrite of potash residue disengages red vapours. When the liquid collected during distillation is acidulated with sulphuric acid, instead of being treated by caustic potash, sulphate of ammonia is obtained as residuum after evaporation. In this case, also, commercial acids must be distrusted, since they often contain ammoniacal salts.

In making various consecutive operations, the concentration of the liquids obtained varies greatly. The author attributes these variations to the differences of temperature, which it is difficult to fix. Diluted with 500 times their weight of water, these solutions often continue to give a blue colour to starched iodide, while at other times the coloration is very faint, if not null.

Evaporation of Pure Water and Alkaline Solutions.

In pursuance of his researches, the author has remarked the formation of the same compound by the simple evaporation of pure water in a porcelain capsule. As proof, it is only necessary to suspend, over the evaporating vessel, papers impregnated with a caustic potash solution. In fifteen or twenty minutes these papers become coloured by contact with the iodised reagent. Linen, well washed in pure water, may be used for the same purpose. The nitrite of ammonia formed during the evaporation of the liquid is carried off by the water vapour, and decomposed by contact with the alkaline liquids impregnating the linen or paper, and which are transformed into alkaline nitrites.

When, in place of caustic potash, the cloth is saturated with hydrochloric acid, the presence of hydrochlorate of ammonia can be shown. The same phenomenon is observable when the evaporation takes place at from 40° to 70° C.; in this case, however, the cloth must be left for half a day in contact with the vapour.

A residuum containing nitrite of potash is obtained by evaporating a weak solution of potash, instead of pure water. Hence it is very difficult to prepare caustic potash, which imparts no colour to the starched iodised sulphuric reagent.

Nitrite of potash is formed also when the evaporation takes place in the open air, and at the ordinary temperature. Filtering paper, saturated with pure water, and dried in the open air, becomes coloured by the starched iodised reagent. All tissues dried in the air usually give the same reaction, as also does sand when washed and dried. In this state, treated with a small quantity of pure water, and then filtered, the filtered liquid produces the reaction of nitrites.

One hundred grammes of water, sheltered from dust, and evaporated in the air to 100th of the primitive volume, yields a liquid which disengages ammonia when treated by potash, and to starched iodide of potassium, with sulphuric acid, gives an intense blue colour.

It results from these experiments, that, whenever pure water, or an alkaline solution, is evaporated, nitrite of ammonia is formed. After prolonged contact with the air, the nitrites or nitrates are visible on the surface of all bodies which have been damped and dried in the air. The author has remarked the presence of nitrite of potash on the surface of glass, especially of roughed glass, which, by reason of its texture, retains more water, and dries more slowly.

Though unable to give a practical solution to this theoretical question, the author is of opinion that the formation of nitrite of ammonia can be explained only by the direct combination of atmospheric nitrogen with water:

$$4N + 3H_2O = N_2O_3 + (NH_3)_2.$$

He reserves the question, whether evaporation in the midst of pure nitrogen gives the same results, and whether it is necessary to effect the combination. However, he has remarked, that in water left for several weeks in contact with the air, in closed vessels, the salt is not formed.

Nitrite of ammonia being, as we have seen, formed by the concurrence of water, air, and heat, it was probable that this product would be found in all products of combustion.

Combustion.

In 1845, M. Schöenbein observed that fatty bodies, as well as hydrocarbides, disengaged, during combustion, a body possessing oxidising properties, colouring starched iodised paper.

With the object of elucidating this matter, he constructed a small sheet-iron furnace, provided with a grate and a chimney. The gases produced by the combustion escape by the chimney. If, by a proper disposition of the apparatus, these gases are made to pass over water, while wood charcoal is burning, the water becomes charged with nitrite of ammonia, provided always that the combustion be not too fierce. A small sponge, saturated with pure water, being suspended in the pipe serving as a chimney, in a few moments the presence of nitrite of ammonia in the water in the sponge is easily recognisable.

The same results are obtained by suspending the sponge above an ordinary lamp, or in a chimney through which wood or coal smoke escapes. However, with coals rich in pyrites no reaction is observable, because sulphuric acid decomposes the salt of ammonia as it forms.

Nitrite of ammonia is not to be found in the products of combustion of bodies which, at the same time, form powerful acids.

The presence of ammonia can be recognised by burning phosphorus, under an inverted receiver, on a plate covered with water, until the water has a strong acid reaction. This ammonia proceeds from the decomposition of nitrite of ammonia in contact with phosphoric acid. The white vapours which form in the receiver are composed of nitrite, as is easily verified by suspending a sponge in them. The nitrous acid decomposes into binoxide of nitrogen and hyponitric acid.

Slow combustion of phosphorus causes also a disengagement of nitrite, which can be collected in a sponge saturated with water.

It is well known that arsenic, heated to about 200°, burns slowly while undergoing transformation into arsenious acid. If, at this moment, it is introduced into

* We have found by experience how difficult it is to obtain sulphuric acid sufficiently pure, and giving no colour to iodised starch solution. However, this is effected by purifying commercial acid from the nitrated compounds it contains, by M. Pelouze's process, which consists in boiling it with sulphate of ammonia.

an inverted receiver, and the operation repeated several times, the liquid becomes charged with ammonia. The air of the receiver contains no nitrous acid, as this acid will be decomposed; for the liquid containing the ammonia contains, at the same time, arsenic acid, formed seemingly at the expense of the oxygen and nitrous acid.

Even sulphur forms no exception. The liquid of the receiver contains sulphuric acid, sulphurous acid, and ammonia.

Applications.

We have seen that nitrite of ammonia is formed, in many cases, of combustion; and it is probable that the same compound is formed in all cases.

The author ascribes the formation of this salt, not to the combustion itself, but to the concurrence of heat, water, and air. He observes, that these results are of great importance to the theory of nitrification.

Chemists admit that nitric acid is formed by the oxidation of ammoniacal salts proceeding from nitrogenised matters, and that atmospheric nitrogen has nothing to do with it. While recognising all the importance of this remark, the author is of opinion that evaporation is the chief agent in nitrification.

Everywhere water is to be found evaporating, especially on the ground; nitrite of ammonia ought also to be found everywhere; and by contact with alkaline bases, alkaline nitrites are formed, which oxidise in the air, and are transformed into nitrates.†

In our rainy countries, nitrites are carried away by the water, and, consequently, do not accumulate; but it is otherwise in hot countries, and especially in certain parts of the West Indies, where the dry season is of several months' duration, and where there are to be found vast plains of alkaline earth.

The presence of nitrogenised matters is not a condition *sine quâ non* of nitrification; nitrate of potash is formed in Bengal, in places where no nitrogenised matters exist capable of furnishing ammonia.

According to the author, attempts should be made to produce saltpetres artificialiy, aided by the data contained in this memoir.

The presence of ammoniacal salts in volcanic vapours, recently confirmed by M. Charles Deville's researches, should be ascribed, says the author, to evaporation only, for it is impossible to admit the presence of nitrogenised matters in volcanoes. Hydrochlorate of ammonia is formed by contact with hydrochloric acid and nitrite of ammonia. Disengagements of hydrochloric acid have likewise been observed by M. Deville.

The formation of nitrite of ammonia is of great importance also in vegetable chemistry. Chemists have proved that plants cannot assimilate free nitrogen. To render assimilation possible, the nitrogen must exist in certain combinations; ammonia and nitrates are supposed to contain nitrogen in a suitable form. If such be the case, nitrite of ammonia, produced by evaporation, contains nitrogen in an assimilable state. Each plant, itself a cause of evaporation, furnishes the portion of assimilable nitrogen necessary to it, whilst the salt is formed, in like manner, in earth moistened by rain.

Presence of Nitrite of Ammonia in certain Fluids of the Economy.

Saliva contains nitrite of ammonia. With addition of sulphuric acid, it colours starched iodide blue. Treated with potash, it throws off white vapours, by contact with hydrochloric vapours, and browns turmeric. These reactions, however, sometimes fail; but that may be caused by the presence in the saliva of sulphocyanide of potassium, which decolorises blue starched iodide. The colour appears only when the nitrite is in excess.

This process is inadmissible for the detection of nitrite in urine, because this liquid has also the property of decolorising blue starched iodide, as M. Pettenkofer's experiments prove.

The pituitary secretions show the reaction of the nitrites; but it varies in different persons, and is not always constant in the same individual. The presence of nitrite of ammonia in these liquids has not been previously observed.—*Verhandlungen der Naturforschenden Gesellschaft in Basel.* 1862, p. 342.

† The author has observed that the "pure" potash of the laboratory almost always contains nitrite, proceeding from the evaporation of alkaline solutions, as can be proved by dissolving it in water, and adding *pure* sulphuric acid and the starched iodised reagent. It is the same with sulphuric acid, and generally with water, distilled or not.

TECHNICAL CHEMISTRY.

On the Manufacture of Hydrocarbon Oils, Paraffin, &c., from Peat, by* B. H. Paul, *Ph. D., late Managing Partner in the Lews Chemical Works, Stornoway, N.B.*

(*Concluded from page* 223.)

With this arrangement work was commenced about the end of August, 1860; but, owing to the wet state of the brickwork, and to a temporary difficulty with the workpeople, it was not until the early part of October that the kilns were got into regular working order. From that time the work was carried on without any considerable interruption until the end of February, 1861. The results obtained during this period were far from being satisfactory. In the first place, the tar made did not amount to more than 3 per cent. of the peat consumed; and, in the second place, the quantity of peat worked did not amount to more than 50 tons a-week on the average. Moreover, the rate of working was subject to wide variation. This latter circumstance, which was productive of much inconvenience, appeared to be mainly determined by the state of the wind. During calm weather the quantity of peat worked was not much more than half that worked when there was a fresh breeze. With a dead calm the action of the kilns would sometimes be entirely stopped, and during gales, which were of very frequent occurrence, it was found impossible to continue working. The most troublesome effect of these two extreme conditions was the production of a back draught from the chimney, through the condenser, towards the kilns, by means of which air became mixed with the vapours and combustible gases; and, when this admixture reached a certain limit, explosions sometimes took place, which were both inconvenient and dangerous.

The slow rate of working, which, as shown by the table, rendered the cost of labour proportionately much greater, was, to a great extent, a consequence of the feeble and irregular draught produced by the chimney. In addition to this, the tar vapour did not appear to escape from the kilns through the 12-inch discharge pipes with sufficient ease. The consequence was, that much tar was condensed among the cold peat at the top of the kiln, and this tar, melting afterwards, ran down to the fire, and was there more or less burnt and destroyed. Hence the small yield of tar.

Since the feeble draught of the chimney was the chief cause of these unsatisfactory results, and since that was itself a consequence of the extreme refrigeration of the

* Read at the Cambridge meeting of the British Association.

vapour and gas during its passage through the condenser, the defective draught might have been remedied by maintaining a fire at the base of the chimney, so as to heat the cold, uncondensed gas escaping from the condenser, where the tar had been deposited, sufficiently to produce a steady draught; but, since the gas escaping into the chimney was highly combustible, this would have been too hazardous a plan to adopt, inasmuch as the weather was frequently so boisterous that it was with difficulty that work could be carried on at all out of doors; and, as the kilns were worked continuously, there would have been much inconvenience attending this mode of working during the very long nights of winter.

Under these circumstances, Mr. Paul thought it desirable to have recourse to some mechanical means of producing a draught that would be constant in its action, easily under control, and which would admit of the gases discharged from the condenser being burnt with safety by the introduction of a water-joint between the condenser and the place where they were burnt. A further reason for adopting an arrangement of this kind was the presence, in the incondensible gases escaping from the condenser, of a large quantity of tar, which was suspended in a kind of vesicular condition, and was not separable by any amount of cooling that was practically applicable. The smell produced by the escape of this tarry gas into the air was exceedingly offensive for miles round, and for this reason, as well as for the sake of using the gas as fuel, it was determined to burn it. Moreover, though the separation of this suspended tar could not be effected by cooling the gas, it was easily separated by mechanical means, such as passing the gas over loose bunches of heather. This plan had been adopted while working with the chimney draught, and, so far as the separation of the tar was concerned, it succeeded perfectly. A long brick chamber was connected with the flue leading to the chimney, so that the gases were made to pass along it in a zigzag course by coming in contact with bunches of heather tied to cords, and suspended from the roof of the chamber. The effect of this arrangement in separating the suspended tar was instantly recognisable, the gases escaping from the chimney being almost free from tar. But the draught of the chimney gradually decreased, and at the end of two or three weeks had ceased altogether. On opening the chamber it was found to be entirely choked with tar that had been deposited upon the bunches of heather like drifts of snow. This circumstance suggested the introduction of several such chambers into the condenser, and it was also expected that the passage of the vapour and uncondensible gas through water would have a similar influence in separating this tar. But to overcome the resistance that would thus be offered to the passage of the vapour and gas from the kilns, it was necessary to have a very powerful draught, and, after considering the various means employed at gasworks for exhausting, Mr. Paul decided upon trying the effect of a revolving fan. A very excellent form of fan of great power was suggested for this purpose by Dr. Rankine, but, as time was a considerable object, one of the ready-made fans manufactured, under Schiele's patent, by the North Moor Foundry Company, was chosen for the trial.

In order to get a satisfactory result in working the kilns, it was necessary to work up at least 70 tons of peat a-week, and to obtain fully 5 per cent. of tar. Assuming that by the application of a fan this result was obtained, then the quantity of uncondensible gas passing away from the kilns might be taken as consisting essentially of the carbonic oxide produced by the combustion of the coke or charcoal yielded by that quantity of peat, plus the nitrogen of the air required for its combustion. Taking the peat to yield 25 per cent. of charcoal, and the quantity worked as 10 tons daily, there would be some 4 lbs. of carbon to be converted into carbonic oxide per minute in the kilns. This quantity would require rather more than 300 cubic feet of air, which, by conversion into carbonic oxide, would become about 360 cubic feet, and, at the temperature it entered the fan, might amount to 500 cubic feet. This, then, fixed the minimum capability of the fan to passing 500 cubic feet of gas per minute, even if the quantity of peat worked did not exceed 70 tons a-week. But this rate of working was considered too small, and Mr. Paul was desirous of increasing it to double or three times as much, and with that object decided upon employing a fan capable of passing 2000 cubic feet of gas per minute, so as to leave an ample margin for increasing the rate of working, and to allow for any augmentation of the volume of gas not calculated for.

The fan chosen for this purpose was a 30-inch Schiele's fan, driven at a rate of 1600 revolutions by an 8-inch engine, which worked some pumps and a winding drum, by which the peat trucks were drawn up an incline to the kilns. This fan was found to produce a powerful, steady draught through 7 inches of water, without raising the combustion at the fire-grate of the kilns to a greater degree than was desirable. The area of the discharge pipes from the kilns having been doubled, the vapour was rapidly drawn from the kilns, and the tar was much more completely separated by passing the vapour several times through water and through four chambers filled with layers of heather. The mechanical action of the fan was also found to be very efficacious in separating the suspended tar, which appeared to be churned out of the gas by the fan.

The current of gas discharged from the fan was highly combustible, and burnt freely at the ordinary temperature. In order to prevent its causing an unpleasant smell, and to render it available as a source of heat for generating steam, distilling tar, evaporating liquors, or drying, it was led through an underground tunnel to a furnace, where it burnt with a flame from 6 feet to 10 feet high, 6 feet long, and 6 inches thick.

In working with the chimney draught, it had become apparent that the quantity of charcoal produced from the peat, as it passed from the top of the kiln to the fire grate, was very much greater than was requisite for distilling off the tar from the subsequent charge of peat, and, consequently, that there was a considerable waste of time, besides other obvious disadvantages, involved in the combustion of this surplus fuel. To remove this obstacle to the increase of the quantity of peat worked in the kilns, an arched opening was made in each kiln, just above the fire-grate, and fitted with a door, through which the charred peat could be drawn out at intervals, in such quantity as to leave only just enough to serve as fuel for distilling the peat. This plan could not be regularly carried out during last winter, on account of the danger of opening the doors of the kilns during high winds while the front of the kilns was unprotected by sheds. It was, nevertheless, found that, by drawing out the surplus charcoal, the quantity of peat worked was very much increased, and a very much more considerable advantage would have been gained in this respect if the removal of the charcoal could have been effected independently of the weather.

As an illustration of the effect of these improved

arrangements, it was shown that the quantity of peat worked was considerably greater than when working with the chimney draught, being in all cases upwards of 70 tons a-week, and, while the weather was favourable for drawing the surplus charcoal, upwards of 100 tons a-week. The yield of tar was also increased to the extent of 7·5 per cent. of the peat worked, and was on the average as much as 7 per cent. The number of men required for working the kilns was also much smaller than was the case while working with the chimney draught.

In conclusion, Mr. Paul gave a comparative view of the results obtained at the Lews works, and of the results anticipated, and those actually obtained at the works of the Irish Peat Company, as shown in the following table :—

TABLE III.

	1		2		3		4		5		6		7	
	Anticipated result's from the working of Irish peat, as set forth in the Company's prospectus, on the authority of Mr. Reece, 1851.	Value.	Sir Robert Kane's report, 1851.	Value.	Working results with Irish peat, as given in Mr. Sullivan's report to the Directors of Irish Peat Company, 1855.	Value.	Retort tar from Lews peat, 1858.	Value.	Kiln tar from Lews peat, 1858.	Value.	Working trial of 1 ton kiln tar from Lews peat, 1858.	Value.	Working result from Lews peat since the fan was used, 1861-62.	Value.
		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.
Quantity of peat worked ..	100 tons	10 0 0	100 tons	10 0 0	100 tons	20 0 0	100 tons	10 0 0	100 tons	10 0 0	100 tons	10 0 0	100 tons	10 0 0
Sulphate of ammonia ..	20 cwt.	12 0 0	20 cwt.	12 0 0	3 cwt.	1 16 0								
Acetate of lime	14 cwt	9 16 0	4 cwt.	2 16 0	—									
Wood naphtha, 5s. per gallon ..	52 galls.	13 0 0	52 galls.	13 0 0	10 galls.	2 10 0								
Crude oil, 1s. ditto	300 galls	15 0 0	300 galls.	15 0 0	—									
Paraffin, 1s. por lb.	300 lb.	15 0 0	300 lb.	15 0 0	300 lb.	15 0 0								
Refined oil, 2s. per gallon ..					150 gals.	15 0 0	999 gals.	99 18 0	535 gals.	53 10 0	500 gals.	50 0 0	749 gals.	74 18 0
Creosote							630 ,,		560 ,,					
Total value of products ..		64 16 0		57 16 0		34 6 0		99 18 0		53 10 0		50 0 0		74 18 0
Cost of material and manufacture		32 2 0		32 2 0		34 3 4		Cost of working not ascertained.		37 10 0		37 10 0		38 14 6
Balance		32 14 0		25 14 0		0 2 8				16 0 0		12 10 0		36 3 6
Value of oils and paraffin ..		30 0 0		30 0 0		30 0 0				53 10 0		50 0 0		74 18 0
Cost of material and manufacture		32 2 0		32 2 0		34 3 4				37 10 0		37 10 0		38 14 6
Balance		2 2 0		2 2 0		4 3 4				16 0 0		12 10 0		36 3 6

The prices set down for peat, and for the products obtained from it, are the same in all the different cases except the statement of working results of the Irish works, in 1855. In that case the cost of peat was 4s. per ton. It must also be mentioned, that in this case the value assigned to the oil, in the above table, is not 5s. per gallon, as given in the company's report, but 2s. per gallon, which Mr. Paul considered nearer to its true value. The difference between the value of the anticipated produce in ammoniacal salts, acetate, and naphtha, and the value of the actual produce in these materials, as shown in columns 2 and 3, was referred to as a strong corroboration of Mr. Paul's views with regard to the working of peat, and to the products determining its value. Besides the very inferior quality of the oils produced at the Irish works, the produce was so small, as compared with the cost of production, as to leave no probability of profit. On the contrary, the Lews peat yields a very much larger produce of oil, of a quality incomparably superior. It was pointed out, also, as an important new feature in the working of this peat, that burning oil of excellent quality was produced from it. This oil, which was sold last winter in Glasgow under the name of Lignole, was examined by Dr. Anderson, and reported by him to compare favourably with the best varieties of mineral oils obtained from coal, shale, and petroleum, the colour being pale, and the smell not unpleasant, the peat oil in this respect greatly surpassing the oils obtained from coal.

Mr. Paul concluded his paper by expressing his opinion that, though the working of peat was surrounded by many serious difficulties as regards both its establishment and prosecution, there was every reason to believe that such peat as that occurring in the Highlands of Scotland could be worked advantageously; and that if the manufacture of these oils, which are now such an important article of commerce, were undertaken with earnestness and perseverance, it would become a means of greatly improving the condition of those remote parts of the country, and a fertile source of profit to those who carried it out.

*On the Prevention of Decay in Timber for Ship-Building and Other Purposes.**

THE author states his opinion that the rapid decay of modern built ships is traceable to this cause alone—that we cannot leave them sufficiently long on the stocks to be seasoned. Such, also, will be the fate of the mag-

* From an essay on the subject by M. de Lapparent, Inspector General of Timber for the French Navy.

nificent cuirassed frigates, if some efficacious remedy be not speedily applied. The risk is even so much the more to be dreaded for the new ships, as the casing of the upper part of the broadside with the iron plates must have the effect of increasing considerably the inertia of the sides; and the variations of her draught during stormy weather will be much greater, when, by reason of the decay of the ribs, the bolting which fastens the planks to the timbers will no longer have sufficient hold.

Timber, sound at the heart, and exempt from all accidental and local defects, only decays under the influence of certain causes, which it is important carefully to define, in order that we may be enabled to combat them successfully. When a tree is felled, it encloses in its fibres, as well as in its capillary channels, a considerable quantity of sap, which is nothing else but water charged with gummy, saccharine, saline, mucilaginous, and albuminous matters. In this state the latter are very liable to ferment, but they lose this liability when, by the evaporation of the sap, they pass to a dry and solid state; so that the first suggestion which naturally presents itself to the mind, is to subject the timber to a lengthened seasoning.

Unfortunately, timber in general, and particularly that of the oak species, requires a very long time before the mass is thoroughly seasoned. This arises partly because (the wood being inaccessible to heat) the sap, excepting that immediately below the surface, does not exude in vapour—the only form in which it could escape quickly—and partly from the incrustation and the narrowness of the channels, which present a more or less powerful obstacle to the evaporation of these exhalations.

A natural seasoning would be sufficient for specimens of moderate thickness, such as boards for inlaying and panelling, &c., &c, or even for some thicker woods, from which in working up they take off only a thin shaving from the surface—for example, the planking of ships; but it would be entirely useless as regards rough square logs intended to be used as ribs, and from which from 40 to 50 per cent. of the original mass is taken off. Then, however seasoned the exterior may appear, a considerable degree of dampness is found under the fibrous tissue of the wood. Exposure of the timber to free air for some length of time can alone remedy this evil; and, as I before stated, such was the course pursued with all ships formerly built, when left to season on the stocks for ten, fifteen, and even twenty years.

Now that circumstances oblige us to forego this excellent plan, it is imperative to replace it by artificial and speedy methods. They consist—

1st.—In depriving the timber of the greatest possible quantity of sap, and, consequently, of the fermenting principles therein contained.

2ndly.—In subjecting felled and sawn timber, before putting together, to an artificial seasoning.

3rdly.—In charring or scorching the surface of the wood by means of a slight carbonisation when the work is finished.

It is a well-known fact, that the longer wood has remained under water, the more rapidly it dries; for instance, in Paris, every one is aware that the firewood brought out of the river is less green, and burns better than that brought by waggon or boat. In reflecting on the cause of a phenomenon apparently so paradoxical, this conviction is forced upon us, that it is of the same nature (or from the same cause) as that which causes the "Endosmose" and "Exosmose" discovered and described by the celebrated naturalist, Dutrochet.

When timber is submerged, the sap, by reason of the matters which it holds in solution, is denser than the pure water; moreover, it is enclosed in fibres or channels permeable at the side. The phenomenon of Endosmose ought, therefore, to be gradually produced, and to extend itself, as by a kind of cementation; so that, in supposing the surrounding water to be flowing, or at least changing, this water will conclude by occupying, if not altogether, at least in a great degree, the place of the sap, which will have issued forth, carrying with it the fermenting principles with which it is charged. The timber, therefore, which has remained sufficiently long in the water, ought to be much less susceptible of fermentation than that seasoned only by the atmosphere. Besides, as pure water evaporates much easier than that which contains certain principles, this timber ought to be seasoned much sooner than the other—a fact confirmed by long experience.

If the preceding explanations are well founded, we should conclude from them that the Endosmose will develope itself with so much greater rapidity, as there shall be a greater difference of density between the surrounding fluid and the sap. On the contrary, the denser the liquid in which the timber is immersed, so much longer will the Endosmose be retarded; and, if there is any difference between the specific gravities of the sap and the water, Endosmose will not be produced.

This remark is most important, as it proves that timber cannot be seasoned in salt water, but in fresh, or, at the most, in brackish water. As to the sea, it can only be regarded as an economical storeyard. The submersion of building timber becomes now so much the more necessary, as floating is very seldom resorted to, the greater part of the timber being brought to the ports by railway.

With regard to the question, "How long it will be necessary to allow the timber to remain in water in order that it may get rid as much as possible of its sap?" the author recommends:—One year in river water, two years in fresh water (frequently changed), and three years in brackish water (which should be always changing). At the close of these several periods, the boards intended for planking should be taken out to be put in store; or they might be left to season themselves naturally for two years, at least, before being worked up. As to the rough timber for ribs, seasoning in store would be, as already stated, totally insufficient; and it would be requisite after shaping, but before putting together, to subject it to an artificial seasoning. There have been many plans of this description in use for some time in France and England, but they have only been applied to wood of moderate thickness, such as boards, flooring, and wainscoting.

The plan adopted in London is the injection, by means of a ventilator, of hot air into the drying stove where the wood is placed; by this the temperature is gently and gradually raised until it reaches boiling heat. But, as wood is one of the worst conductors known of caloric, if this plan is applied to large logs, the interior fibres still retain their original bulk, while those near the surface have a tendency to shrink, the consequence of which would be cracks and splits of more or less depth. If, however, this defect is not too apparent, it would have little influence on timber used as ribs, but would render it unfit for planking.

Another method in operation at this present time, at Tourlaville, near Cherbourg, for which the inventor, M. Guibert, has taken out a patent, appears, in the author's opinion, to give at once more expeditious and sure results than those obtained from the use of dry and hot air. It consists in filling the drying stove with smoke produced

by the distillation of certain combustible matters, such as saw-dust, waste tan, and smiths' coal, &c. By means of a ventilator, ingeniously arranged, a rotatory movement round the logs laid to season is given to the smoke, so as to obtain an average uniform temperature in every part. By this plan, as the distillation of combustibles is always attended with a considerable discharge of steam, all cracks and splits appear to be prevented.

The apparatus invented for the same purpose by Messrs. Lège and Fleury Pironnet, for the injection of sulphate of copper into beech and poplar, may likewise be used. This apparatus is composed of a cylinder 15 or 16 mètres (or from 49 to 52 feet) in length, with an opening of about 2 mètres (or 6½ feet), into which, after the wood is placed and the opening hermetically sealed, a jet of steam is introduced, intended at first to enter the timber and open its pores for the purpose of obtaining a sudden vacuum, so as to establish at any time a communication between the interior of the cylinder and the cold water condenser, like Watt's condenser, at the same time that the air-pump is put in action. The vacuum caused is very powerful, equal to an altitude of 65 centimètres, or 25½ inches of the barometer. Under the double influence of the heat and the vacuum, the sap is quickly evaporated from the wood as steam, and ejected from the cylinder by the air-pump, so that in a very short time the wood is fully prepared to admit the preserving liquid through the entire bulk. If the wood is only required to be seasoned, a current of warm air is substituted for the liquid, and to this a certain proportion of sulphuric acid should, in the author's opinion, be added. Without doubt, this method of seasoning would be the quickest, and we should thereby avoid the cracks and splinters which are nearly always produced when dry and hot air only is applied.

The principal drawbacks to the use of the apparatus are its complicated details and heavy cost; but the result to be obtained is most important.

A species of embalming was one of the oldest methods adopted. We are aware that, from time immemorial, either aromatics or poisons have been successfully employed in the preservation, for an almost indefinite period, of defunct organic bodies; and as animal substances and grasses, which otherwise decomposed with the greatest rapidity, are those whose tissues most readily admit preserving liquids, it is, of course, with them that the plans of preservation will best succeed. The effect of the poisonous solutions employed appears to be an insoluble combination of those solutions with the albumen of organic matters, by arresting their fermentation, which always precedes cryptogamic or fungoid vegetation, or the deposit of the eggs of xylophagous insects.

Dr. Boucherie's plans for preserving timber have some connection with this method; and although he has not succeeded in their adaptation to the most valuable building timber, he will not the less have rendered an immense service to France, by substituting, in lieu of oak (the scarcity of which is continually increasing), other kinds of timber suitable for many purposes, and especially for railways. In fact, experience has shown that timber is permeable, at least by aqueous solutions, only so long as the sap channels are free from incrustation. Such, in general, is the case with beech, elm, poplar, hornbeam, and the service tree, the capillary tubes of which are always open, or at least close very slowly. At the same time, it may be said that there must remain, even in these species, some parts impervious to injection, while it is almost impossible but that a certain portion of the fibres will be more or less incrusted.

The sap woods, on the other hand, of every species, appear quite pervious; and on this quality is based the preparation of telegraphic poles, which, as every one knows, are made of young fir trees stripped of their bark, the inside of the fir, like that of most of the common resinous trees, being impermeable. But in all these cases, these preparations are only to be applied to wood in the store or yard, or to that prepared, but not put together.

The principal cause of the fermentation—always the forerunner of decay in timber—is the presence of an atmosphere of warm, damp, and stagnant air. On one of these three conditions being removed, the durability of timber would be immediately prolonged. Thus it is that we cannot contemplate without a feeling of admiration the woodwork of the oldest mansions or churches. The joists of the houses built by our ancestors last almost for ever, because they are in contact with air which is continually changing. Now, on the contrary, we foolishly enclose them between a ceiling of plaster (always very damp to begin with) and a floor; they rapidly decay, and sometimes cause the most serious disasters, of which it is impossible to be forewarned. The timbers of our ships, placed as they are between the outside planking and the inside ceiling, are in the same predicament; the stagnant air of the channels is heated by the vicinity of the hold, and at the same time is charged with moisture, as much from the constant emission of aqueous vapour from the wood as from the leakage of water through the seams, which, during rough weather, always open a little. Thus it is the timbers decay with frightful rapidity, endangering either the ship or the health of her crew.

The bolting ought to be considered as the only safeguard of a ship; for the planking, which enables her to float, only discharges that duty in proportion as it is solidly fastened to the ribs. But the grip of a bolt being proportionate to the friction that it experiences in the channel where it is driven, and that friction proportionable to the spring developed in the wood when the bolt is driven in, if the sides of the channel are altered, the adherence of the bolt is considerably lessened, the planks play one upon the other, eject the caulking, and allow water to penetrate through the seams. Under these circumstances, the ship is no longer seaworthy, and must seek the nearest port to be repaired.

The signs of decay in timber are fungi. Some of them, now and then, are microscopic, and owe their existence to the sporules deposited on the surface; while fermentation, generated by prolonged contact with warm, damp, and stagnant air, is as a soil where seeds sow and nourish themselves. When a ship is under repair, we are often astonished at the appearance of fungi, enormous in length or bulk, which are visible on all the surfaces of the circumference of the ribs in contact with the planks; and we may observe, that the depth of the decay, from the outside to the inside, is in proportion to the size of the fungi. In general, however, they are not so abundant in the channels, or on the surface lengthways. This tends to show, that the air in the fibrous tissue of the wood is not absolutely stagnant, the differences of the temperature of the several layers causing a slight current of rising and falling air. It is not the same even with the thin draughts of air enclosed on the surface in contact with the planking and the timbers; the friction that these draughts experience is sufficient to render their stagnation complete, it being a well-known fact, that timber decays principally when in contact.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

November 6, 1862.

Professor A. W. Hofmann, *LL.D., F.R.S., President, in the Chair.*

The proceedings of the session commenced in the usual manner, by reading the minutes of the last meeting.

A paper, by Mr. C. Tookey, was then read by the Secretary, the substance of which had reference to the analytical separation of the metals, antimony, tin, and lead. The author referred to the difficulty which had hitherto been experienced in effecting this object. In the analysis of antimonial lead, for instance, by operating upon equal weights of the alloy with nitric acid, evaporating at a steam temperature, and extracting with water, it was impossible to obtain a constant result by weighing afterwards the antimonious acid, on account of the variable amount of lead retained in an insoluble form. By taking advantage of the volatility of some metallic chlorides, a perfect separation might in many cases be accomplished. Thus, if the mixed oxides of lead and antimony be submitted to the action of hydrochloric acid gas, the terchloride of antimony was easily produced and volatilised, whilst the chloride of lead remained behind. Tin, in the form of bichloride, was volatile, but the protochloride, like the corresponding compound of copper, was fixed. The terchloride of arsenic was very volatile. The mixed sulphides of these metals might also be acted upon by hydrochloric acid gas; and for this purpose Mr. Tookey preferred the use of a piece of hard combustion tubing, expanded in the middle to form a bulb, and having the ingress and exit tubes bent at angles of 45 degrees, but in opposite directions; the first pointing upwards, for convenience of introducing the substance, the other downwards, for collecting the volatile product in a beaker of water or dilute acid. The temperature should be moderated until the action of hydrochloric acid upon the sulphides is nearly accomplished; and for the disengagement of the gas the use of fused chloride of sodium and oil of vitriol was recommended. For separating antimony and tin, a process of reduction by metallic iron answered admirably. The hydrochloric solution of the mixed metals was digested in the cold with pure iron wire, when the antimony alone was reduced to the metallic state, the tin remaining in solution as protochloride, which could then be separated from the iron by sulphuretted hydrogen, collecting the precipitated sulphide as usual, and weighing in the form of binoxide of tin. The reduced antimony should be purified from traces of iron by digesting with cold dilute hydrochloric acid, washing with cold water, drying in a water oven, and weighing the metal in the state of grey powder.

Dr. Frankland bore testimony to the general accuracy of Mr. Tookey's process of separation. Having employed it in the analysis of lead and composition pipes, he found it possible to obtain results so concordant that two-tenths or three-tenths per cent. was the limit of error.

Dr. Williamson recognised the importance of a really efficient method of analysis, more particularly from the circumstance, that several erroneous statements had lately been made in regard to the separation of these metals. He warned the Fellows of the Society against depending upon the accuracy of a proposal made by an eminent Continental chemist, to the effect that the mixed sulphides of antimony and arsenic could be quantitatively separated by treatment with a solution of bisulphite of potassa.

A paper was next read, by Edward Nicholson, Esq., Staff Assistant-Surgeon, on "*The Volumetric Analysis of Waters.*" The author based his system of analysis upon the soap-test originally introduced by Dr. Clark, and more recently elaborated by certain French chemists. The degree of hardness ascribable to the total amount of dissolved constituents was, in the first place, ascertained; then the reduction consequent upon boiling the water. In proceeding to discriminate between lime and magnesia as sources of hardness, the author repeated a statement to the effect that, although the carbonates of lime and magnesia were precipitated together on boiling, the whole of the carbonate of magnesia redissolved on subsequently cooling the water. If it be required to distinguish between lime and magnesia hardness, the earth first named might be precipitated by a known quantity of oxalic acid, the oxalate of lime filtered off, and the excess of the organic acid determined by a standard solution of permanganate of potassa. Sulphuric acid was to be estimated by means of a standard solution of nitrate of baryta, and the chlorine determined in a similar manner with solution of nitrate of silver. With regard to the state of combination of the chlorine, the author considered it sufficient for practical purposes to assume the existence of the whole in the form of common salt; his method of examination did not comprehend a search for potash, which he believed but rarely occurred as a constituent in waters.* For the amount of iron the sample of water was to be evaporated to a small bulk, a few drops of hydrochloric acid added to redissolve the peroxide of iron, which, after reduction by sulphurous acid, was then to be estimated in the usual manner with standard solution of permanganate of potassa. For the determination of hardness, the author preferred the use of soft potassa soap, instead of the hard curd soap usually employed. He recommended that two parts of olive oil should be dissolved by heat in five parts of liquor potassæ of the Pharmacopœia, and that the solvent employed should consist of alcohol and water in the proportion of equal parts.

The President objected to the assumption, that the alkaline salts were always those of sodium, and that, inasmuch as the atomic weights of the alkali metals were widely different, considerable errors might sometimes be introduced into the calculations. He enquired of Dr. Nicholson whether he had yet made any comparative experiments upon the same sample of water by his proposed method against the older, granimetric system of analysis?

Mr. Dugald Campbell would restrict himself to a single remark upon the fallacy of determining the amount of iron by permanganate of potassa in a solution, which was known to contain organic matter. He had made experiments with this very agent as a means of ascertaining the amount of organic matter in waters, and he would particularly caution Dr. Nicholson against using this method in the analysis of waters he would be likely to meet with in India; for, according to the instructions just now given, a sample of water charged with much organic matter would be reported highly chalybeate.

Dr. Nicholson replied that, whenever organic matters were known to be present, it was easy to destroy them by carrying the evaporation to dryness prior to estimating the amount of iron. In answer to the President, Dr. Nicholson stated that he had made many examinations by his process of the water supplied to Fort Pitt, Chatham, and that the results generally were closely concordant; but he could not say he had yet instituted a comparison between the two systems of analysis.

A letter from Professor Hind, addressed to Dr. H. Bence Jones, was read, in which, referring to urinary deposits, it was stated, as a general conclusion, that, in the absence of potash, lime was necessary in order to induce the formation of deposits having an amorphous character.

The fourth communication was on "*Hypobromous Acid,*" by Mr. E. Dancer, student in Owen's College, Manchester. The author commenced by referring to the un-

* The author did not make any reference to the possibility of magnesium being partly combined with the chlorine, which must, of necessity, be the case in waters derived from wells subject to the infiltration of the sea.—Ed. C. N.

certainty regarding the nature or even existence of this compound, and to the fact of its receiving but meagre notice in published works on chemistry. On bringing bromine in contact with a strong solution of potassa, a bromide and a bromate were simultaneously formed; but if dilute caustic alkali be employed, or a solution of the carbonate, the liquid assumed a yellow tint, and then possessed bleaching properties. In this case, besides the bromide, a hypobromite was formed, to the presence of which the odour and general behaviour of the solution might be ascribed. The alkaline earths appeared to act in a similar manner. On bringing the red oxide of mercury, or better, the precipitated form of that substance, into contact with bromine water, a solution of hypobromous acid was formed; but in attempting the distillation of this liquid in the usual manner, it was found that red vapours of bromine appeared in the retort, and that, in fact, the heat employed split up the compound into its elements. The author succeeded, however, in procuring this acid by adapting a cooled receiver, and removing the pressure of the atmosphere. The yellow liquid so prepared had an acid character and agreeable odour, vegetable colours were quickly bleached by it, and throughout it presented properties which brought it into close analogy with hypochlorous acid. By analysis it furnished bromine and oxygen in the proportion of equal equivalents. An attempt was made to prepare this acid by passing the vapour of bromine over dry oxide of mercury, but in no instance was any other result observed than the formation of bromide of mercury with liberation of oxygen gas. This experiment was tried at the ordinary temperature, at 100° C., and in a freezing mixture, but under all circumstances the products were identical. When bromine was brought into contact with nitrate of silver, hypobromous acid was formed, which with the liberated nitric acid remained in solution, bromide of silver being at the same time precipitated. By studying quantitatively this reaction, it was found that half the amount of bromine added was consumed in the formation of hypobromous acid, the other half combining directly with the silver. Equal portions of bromine water were taken, the first precipitated with nitrate of silver alone; the second treated with the nitrate and a reducing agent, so that no hypobromous acid could be formed. The bromide of silver being collected in each instance, the one portion weighed exactly double of the other, proving the following equation to be correct:—

$$Br_2 + Ag\,O, NO_5 + HO = BrO + Ag\,Br + HO, NO_5.$$

By employing the oxide of silver instead of the nitrate the results were less certain, oxygen gas being usually liberated; but when the bromine water was used in larger proportion, and poured off quickly from the remaining oxide, a solution was obtained containing both silver and hypobromous acid; and which, on standing, soon became decomposed with precipitation of bromide of silver. Great care having been bestowed upon the purification of the sample of bromine employed in these experiments, the author further determined the degree of solubility of this substance in water at different temperatures. A table showing the results is appended by way of conclusion to the paper.

Mr. Spiller stated that the subject of the communication just now read was especially interesting to him from the circumstance of his having, some three years ago, worked in this direction. In the Chemical News, of December 31, 1859, would be found a "Note on the Existence of Hypobromous Acid," and some experiments described by which its composition and general similarity to hypochlorous acid were clearly established. The action of bromine upon nitrate of silver afforded, perhaps, the most complete insight into the nature of this compound, and was that particularly investigated; it proved to be analogous to the action of chlorine as described by Balard, and furnished likewise an acid solution having powerful bleaching properties. Many other reactions in support of this view had been examined by Mr. Spiller before he ventured to announce the existence of hypobromous acid, and he could not, therefore, yield to Mr. Daneer the credit of discovery; at the same time, he would freely acknowledge that our information regarding this acid had been greatly extended by the admirable researches just now submitted to the Society.

Dr. Odling explained that there was a foot-note appended to the paper which he had omitted to read, in which Mr. Spiller's name occurred, and a reference made to his contribution to the Chemical News.

Before adjourning the meeting to the 20th instant, the President announced the titles of three papers, which will then be read:—On "*The Reactions of the Organo-metallic Radicals*," by G. B. Buckton, Esq., F.R.S.; on "*The Analysis of Urine*," by Dr. Woods; and another on "*The Specific Gravity of Urine as a Measure of the Salts in Solution*."

PHARMACEUTICAL SOCIETY.

Wednesday Evening, November 5, 1862.

Mr. T. N. R. Morson *in the Chair.*

The Herbarium Prize, for a collection of British plants, was presented to Mr. Hopwood.

Professor Bentley said that this year there had been but one competitor for the prize; but he considered that Mr. Hopwood's collection well deserved the reward. The reason there had been no other competitor was, most probably, the old regulation which made the herbarium gaining the medal the property of the Society; and he wished it to be known that the Council had consented to abolish this regulation, so that for the future the collection would remain the property of the successful competitor.

Mr. Attfield exhibited a large calculus which had been found in the cœcum of a horse. It was about the size, and of the form, of a Dutch cheese, and externally looked like Bath or Caen stone. It was composed of the ammonio-phosphate of magnesia, the crystals of which were bound together by vegetable fibres and hairs, the nucleus being a small flint pebble. Such concretions, Mr. Attfield said, were generally found in horses which were employed in slow, heavy in-door work, as in mills, and were fed on bran and mill refuse. No phosphate of lime was present in the stone, which he considered a remarkable circumstance.

Dr. Edwards said that the Liverpool Museum contained two such stones of a larger size, but not so regular in form as that on the table. One of those weighed 11 lb., and the other 13 lb.

Mr. Bottle said these concretions were not novelties. As an old member of the Veterinary Profession, he had seen many such. The large ones were sometimes accompanied by two or three smaller stones, which were generally polished by attrition. They were generally found in millers' horses, which were fed on bran and millstone grit. He would have expected a large amount of silica to be present in the stone.

Mr. Attfield said that the concretions which were sometimes found in the stomach did usually contain millstone grit, but not those found in the cœcum: the latter always contained salts not soluble in alkalies.

Mr. Maxwell related a very doubtful case of supposed poisoning by an arsenical paper, and exhibited a piece of the paper. He wished the Society to assist in making known the dangers arising from the use of these papers.

The Chairman said, there appeared to him to be very little arsenic on this particular paper, and he believed the evils attributed to these papers had been very much exaggerated. If person living in rooms hung with these

papers were poisoned, the makers of the papers ought to be poisoned also, which was not the fact.

Mr. Bottle thought that the use of these green papers at the seaside and in damp situations might be dangerous. The damp, he thought, might loosen the pigment from the paper.

Dr. Edwards considered all the supposed cases of death from arsenical papers more than doubtful, and did not believe that any person could be killed by arsenic, and yet the arsenic not be discoverable in the body. He related, that some years ago, in Liverpool, five children were poisoned by eating green sweetmeats. The three youngest died, the two elder recovered, and he was able to detect arsenic in the excretions of these two children (which he examined once or twice a-week) for more than a month after the poison had been swallowed.

Professor Redwood made some remarks on Methylated Spirit. He said that fears were entertained by some persons that the Excise would soon withdraw the permission to use methylated spirit, or the revenue must suffer. These fears might be set aside at once. He had reason to know that the Board of Excise was perfectly satisfied with the working of the measure, and that they had no reason to suppose that methylated spirit was applied to any illicit purpose. It was well known that the spirit could be deprived of much of its disagreeable odour and flavour, or cleaned, as it was called, but this could not be done in a way which would make the operation profitable. The cleaning did not consist in the separation of the alcohol and wood spirit, but simply in removing the impurities of the latter. The Professor then alluded to the specimen of potable wood naphtha, shown in the International Exhibition by Mr. Eschwege, and said that the process of this gentleman was a patented one, which had never been worked commercially, and not more than a gallon or two of the spirit had ever been made. The process itself was no novelty, for something very much like it had been patented sixteen years ago by a Mr. Blumberg, for the purification of wines and spirits, and was then tried by the chemists of the Excise, and found not to answer. Professor Redwood then described the process of Mr. Eschwege, as given in the paper of Mr. Napier Draper, which we have recently published (Chemical News, Vol. vi. p. 195), and said that such a process necessitated the use of a cumbrous plant, involved a considerable loss of material, and was altogether of such a nature that it could never be employed to defraud the revenue.

The discussion on the use of methylated spirit in pharmacy was adjourned until the next meeting, in consequence of the small number of members present.

Mr. Veizer then read to the meeting a letter which had appeared in the *Lancet*, calling attention to the fact, that some new preparations to be introduced into the new Pharmacopœia are being prescribed, and that patients are directed to one or two establishments, at which only these preparations can be obtained. He expressed an opinion, that whoever had communicated the secret had been guilty of an atrocious breach of trust, and, if a member of the Society, he thought the laws of the Society would justify the expulsion of an individual who had been guilty of such conduct.

A long and desultory conversation ensued, which it is impossible to report at length; but we may state in a few words the general purport. It was alleged that some prescriptions have been written for a *Linimentum Belladonnæ Pharm. Britt.*, and that these have been directed to one or two establishments, the proprietors of which were willing to retail the preparation to the trade, at the modest price of one shilling and sixpence per ounce. In the course of the conversation the Chairman argued that such a thing could not possibly have happened, because no such book as the "British Pharmacopœia" was in existence. It was rejoined, however, that the manuscript of such a work was in existence, and that there were parties who had access to this manuscript, or other opportunities of becoming acquainted with its contents; and it was contended that these parties were taking an unfair advantage of their brother druggists, one member going so far as to assert, that if the publication of the "Pharmacopœia" were delayed another year, the compounding of prescriptions would pass into very few hands. Dr. Edwards recommended members not to "foul their own nest" by making envious remarks on other members. He did not consider that any one had a grievance. There was no such thing as the "British Pharmacopœia" in existence. The formula was private property; and when a name was placed on a prescription he did not consider that any one else had a right to it. To which a member replied, that the manuscript of the British Pharmacopœia was public property, and persons were guilty of a breach of trust who secretly prepared medicines, the composition of which had been made known to them at Pharmacopœia Committees.

After a recommendation, that the attention of the Council of the Society should be called to the matter, the conversation dropped, and the meeting adjourned.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

2035. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment or preparation of British and foreign algæ, and the application of the same to various branches of the arts and manufactures."—Petition recorded July 15, 1862.

2220. Jean Sirou, Castelsarrazin, Tarn et Garonne, France, "A new medicinal preparation for internal and external application."—Petition recorded August 8, 1862.

2311. Samuel Alexander Bell, Epping Villas, Stratford, Thomas Higgins, Carriaco Terrace, Bow, Middlesex, "Improved apparatus for dipping lucifer matches."—Petition recorded August 16, 1862.

2542. William Clark, Chancery Lane, London, "Improvements in the treatment of peat and peat tar, for the production or manufacture of various produets, and in apparatus for the same. A communication from Leopold Eugene Lavigne, Boulevart St. Martin, Paris.—Petition recorded September 16, 1862.

2571. Johan Bernhard Giertz, Great St. Helen's, London, "Improvements in gas burners or jets."

2634. Michael Henry, Fleet Street, London, "Certain new and improved appliations of petroleum and its produets, certain agents produced by combining the same with other substances, and certain modes of treating caoutchoue, gutta-percha, and their compounds, and substances similar thereto."—A communication from the Société Chartier et Compagnie, Boulevart St. Martin, Paris.—Petition recorded September 27, 1862.

2654. Alexander Prince, Trafalgar Square, Charing Cross, London, "Improvements in the manufacture of varnish, printing ink, paint, and printing colours."—A communication from David Steinert, Hamburg.—Petition recorded September 30, 1862.

2712. John Beale, Hope Street, Maidstone, Kent, and Mary Ann Beale, Upper Brunswick Terrace, Barnsbury, London, "Improvements in the preparation or manufacture of manure."—Petitions recorded October 7, 1862.

2718. Pierre Clavel, Paris, "Improvements in the treatment of violet colours derived from coal tar oils."

2726. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the manufaeture of paints or pigments."—A communication from Charles François Leopold Oudry, Paris.

2729. Joseph Bence Palser, Crown Hotel, Holborn,

London, "Improved apparatus for manufacturing paper pulp, and recovering the alkali used in such manufacture."

2748. Alfred Vincent Newton, Chancery Lane, London, "Improvements in evaporating apparatus applicable for the manufacture of sugar."—A communication from Théodore Champierre de Villeneuve, Rue St. Sébastien, Paris.

2756. Charles Thomas, Bristol, "Improvements in the manufacture of silicate of soda, or silicate of potash, and in the manufacture of artificial stone."

2770. Richard Archibald Brooman, Fleet Street, London, "Improvements in apparatus for carburetting gas."—A communication from Louis Bricourt, Julien Bricout, and Emile Berlet, Rheims, France.

2772. Edward Henry Cradock Monckton, Thurloe Place, South Kensington, London, "Improvements in coils of induction, and in obtaining and applying power by means of electro-magnetism."

Notices to Proceed.

1785. Samuel Hazard Huntly, Upper Baker Street, Regent's Park, London, "Improvements in the construction of furnaces for effecting the more perfect combustion of the fuel."

1825. Arthur Warner, Threadneedle Street, London, "Improvements in the manufacture of pigments or paints from certain refuse materials."

2311. Samuel Alexander Bell, Epping Villas, Stratford, and Thomas Higgins, Carriaco Terrace, Bow, London, "Improved apparatus for dipping lucifer matches."—Petition recorded August 16, 1862.

2667. George Jordan Firman, Millwall, Poplar, London, "Improvements in the treatment of certain salts of potash and lime."—Petitions recorded October 2, 1862.

CORRESPONDENCE.

"A Question for Chemists" Answered.

To the Editor of the Chemical News.

Sir.—In the Chemical News of October 25, a correspondent enquires for the changes produced when a solution of protonitrate of mercury in water is heated along with iron wire, and for an equation to represent these changes. As no one has as yet answered this question, I will, with your permission, attempt it. The nature, as well as the rapidity of the reaction, depends, I believe, to a considerable extent, on the temperature: the following equations will, I think, express the changes when the solution is at the boiling point:—

1st.—$12Hg_2ONO_5 + Fe_{14} = 3(Fe_2O_33NO_5) + 3NO_2 + 4Fe_2O_3 + 24Hg.$

2nd.—$6(Fe_2O_33NO_5) + Fe_{20} + 12HO = 3NH_4ONO_5 + 12FeONO_5 + 10Fe_2O_3.$

I am convinced that the changes are not always the same; but as I have made only two or three experiments, and those hurriedly, I have not determined the conditions which regulate the particular decompositions.

I am, &c. K. K.

On the Question of Alum in Bread.

To the Editor of the Chemical News.

Sir.—As in No. 151 you called the attention of chemists to the above matter, I have been induced to review it; and it appears to me that if chemists generally were to adopt a modification and improvement of the tannin method mentioned by me in No. 107 of the Chemical News, the uniformity and certainty of results you so much desired would be attained. The following are particulars of the process:—

1st. Incinerate 8 ozs. of the bread or flour in a black-lead crucible to a charcoal; reduce it to a fine powder in an *iron* mortar.

2nd. Boil the powder in diluted muriatic acid for about half an hour and filter.

3rd. Add to the filtrate carbonate of soda in excess; filter and collect the precipitate, which consists of salts of iron, lime, and magnesia, with the alumina and phosphate of alumina; well wash the precipitate.

4th. Pour on to the precipitate in the filter, about an ounce each of liquor potassæ and water, and keep putting it back on the filter two or three times, so as to dissolve out all alumina, which is the only substance extracted, save a little silica.

5th. Add to this alkaline solution of alumina, so much of a solution of tannin; then carefully neutralise this with q. s. of hydrochloric acid, when we get a precipitate of tannate of alumina; project on to a cloth, filter, and, after washing and draining it, press out by the hand as much of the remaining water as possible. The filtrate contains all the phosphoric acid; and if the proportions of materials have been well adjusted, not a trace of alumina will be perceived on the addition of aq. ammonia; if so, it must be put back in the filter.

6th. Place the pulpy brown tannate in a small Hessian crucible, and insert it in the centre of a clear fire for about an hour, when the pure alumina will be obtained of a snowy whiteness; or we may, if preferred, pour on the magma contained in a small Berlin crucible some nitric acid, boil and evaporate to perfect dryness, retaining it at red heat for a few minutes. This also affords pure and snow-white alumina. Care must be taken in this case to avoid any spurting of the acid liquor, or some loss may be sustained.

The alumina is now in a fit state for further experiments. It should be entirely soluble in liq. potassæ; and the addition of acetic acid in excess should not produce any turbidity or precipitate which would indicate the existence of phosphate of alumina, which is insoluble in that medium. Every grain of pure alumina exactly represents 9 grains of common alum.

Having now suggested a perfectly reliable method of extracting and estimating alumina in bread and flour, it only remains to determine how far alumina obtains in wheat as a normal constituent. Some chemists have affirmed that it does; but may they not have mistaken traces of silica, as both are soluble in liq. potassæ? I am at present engaged in a series of experiments on that point, and will report progress in a few days.—I am, &c.

John Horsley, F.C.S.

The Laboratory, Cheltenham, November 8.

Purification of Pyroxylic Spirit.

To the Editor of the Chemical News.

Sir,—I have become aware of some statements in the *Pharmaceutical Journal* of this month, about my process to purify pyroxylic spirit, which may lead the public to believe that it is impracticable on a manufacturing scale; and I, therefore, beg to say, that it is not only practicable in the manner described, but that the cost of purification will be under sixpence the gallon of full strength on a large, and profitable even on a small scale.

My process proves, that the notion to free spirits from their deleterious impurities by distillation is erroneous, and that they must be separated, by destroying the affinity of spirits for them, by the greater one for water, and by subsequent sufficient charcoal filtration.

The analysis of pyroxylic spirit, and its boiling point differing from spirits of wine, are well known, perhaps not its less fiery effect on the tissues of the tongue in its pure state, and its easy distillation to nearly 100 per cent. without the aid of lime.

As it appears that the question of potable wood naphtha is now creating some interest, I offer, with a view to facilitate researches into its properties, to place at the disposal of any one scientific institution, not too distant from the British Museum, an apparatus which I had made, to come to practical results, and to have there purified, under my directions, any quantity wanted for merely scientific purposes.

With regard to methylated spirit, suffice it to state, that I acquainted the Board of Inland Revenue of the results of my experiments about eighteen months ago.

I am, &c.

H. Eschwege.

14, Mincing Lane.

Non-inflammable Fabrics.

To the Editor of the Chemical News.

Sir,—The odd pieces of cotton enclosed have been dipped into a solution, containing silica, lime, alumina, and soda, manufactured by us—simply dipped, and not ironed or pressed to give stiffness. We shall be glad to have your opinion upon the usefulness, or otherwise, of our solution.

We are, &c. Jesse Rust & Co.

Lambeth Glass Works, Carlisle street, S.

[The specimens laid before us by Messrs. Rust and Co. take fire with difficulty, and, unless held directly in the flame, soon go out. We have no doubt that the mixture, after a few experiments, could be prepared to answer the desired purpose.—Ed. C. N.]

To the Editor of the Chemical News.

Sir,—Respecting the use of chemical substances as materials suitable for preparing flame-proof starch, as claimed by Versmann and Oppenheim, I have repeatedly, in various publications, referred to the use of sulphate of ammonia; and I have abundant witness that in the year 1858 I was engaged in making refined sulphate for that express purpose. On one occasion I forwarded 28 lb., as sample to a practical chemist in London, who will at any time come forward in proof of my statement. I can produce other conclusive testimony. I afterwards made an arrangement with Mr. James, of Plymouth, by which he was to carry out the suggestion, when, to my surprise, I was mulcted in all my fees, through his hearing that Versmann and Oppenhein had patented the very thing that I had been doing long before.

Do not the patent laws require revision?

I am, &c.

John S. Blockey.

Hyde Park, Leeds.

To the Editor of the Chemical News.

Sir,—Noticing in your Journal of Saturday last a letter from Messrs. Maltby Brothers, inquiring whether any of your subscribers could tell them of a non-inflammable substance, which might be mixed with starch, sufficiently cheap to meet the demands of the public, I beg to inform those gentlemen that I am now manufacturing a non-inflammable starch, known as the "Patent Incombustible Starch," which, upon trial, will, I believe, meet the requirements of those gentlemen.

In their letter, Messrs. Maltby Brothers say, they are aware that several compounds have been employed for this purpose; but, either from the high price, corrosive nature of the constituents, deliquescent properties, or large quantities required, are not applicable to all fabrics. In reply to which I would inform those gentlemen, that our starch is not of high price, being sold in packets as low as ½d., 1d., 2d, &c., each; that it contains no corrosive ingredients nor deliquescent properties; and that it is applicable to all kinds of fabrics, for dress or for domestic use, being adapted both for stiffening and for non-stiffening purposes. It irons easily without sticking, yields a glossy surface, and renders the articles entirely flame-proof. It would afford me great pleasure to give those gentlemen, or any of your readers, full evidence of the excellent qualities of this starch, feeling confident that the use of the "Patent Incombustible Starch" would effectually prevent the fearful sacrifice of life to which those gentlemen refer.

—I am, &c. J. Pepper.

Patent Incombustible Starch Works,
28, Rushton Street, Hoxton.

MISCELLANEOUS.

The Oil Springs of America and Canada.—The transactions of the last fortnight are characteristic, simply from their caution and reticence. A steady, but not a large business has been effected, the very unexpected high prices challenging reflection as to their propriety and permanency; as well as consideration as to whether the enormity in the advance of Crude was attributable to its merits, or to superficial influences. Without exception it is studiously admitted, that Petroleum, at twice its cost laid down here, is unquestionably, from its valuable and prolific sequences in refining, the most wonderful and sterling donative of nature since the El Dorados of California and Australia. *Crude.*—After a capricious demand at 20*l.* for American, prices gave way to 18*l.* 10s. to 19*l.*, at which latter, to 19*l.* 10s., there is now a strong demand, sellers once more requiring 20*l.* In Canadian a fair demand at 12*l.* 10s. to 13*l.* 1500 casks by the *Syrius*, from Montreal, now a wreck, sold at 12*l.* 15s. for U. K., or 13*l.* 5s. for Continent. Gross sales about 3500 casks since the 18th ult. *Refined.*—After all that has been said, written, and asked for, the greatest disappointment is expressed by consumers here at the utter inequality of what is sent over. So far as point of ignition is concerned, the response has been earnest; but the colour and odour are so offensive as to render it perfectly obnoxious alongside the best white British refined; and, unless a marked improvement is at once evinced, the American refiner must bow to the British. Steady sales are being made at 2s. 4d. for tinged and lemon, down to 2s. 2d. to 2s. 3d for yellow and amber. *Benzine or Spirit.*—Strong buyers at 2s. 3d. to 2s. 6d., and market cleared. *Lubricating Oils and Wax.*—We are, and have been, without for some time past, so that quotations are unchanged. *Casks.*—Shippers are exhorted to see to the condition of these, not the least important requisite to a successful consignment. A large per-centage arrive empty.—*From Alex. S. Macrae's Circular*, Liverpool, November 8.

ANSWERS TO CORRESPONDENTS.

Inquirer.—Ether is the best solvent,—or benzole may be used.

A Subscriber, Cork.—Sulphuretted hydrogen water, or sulphide of ammonium, will instantly detect lead in the cloth.

Reader.—A gentle heat will separate iodine from its compound with starch.

Amateur.—Plumbago crucibles are unsuitable for cylinders in Bunsen's batteries; they contain a considerable quantity of clay. For general use, we much prefer Grove's to Bunsen's batteries.

M. P. S.—We have not seen the formula for the Linimentum Belladonnæ Pharm. Britt. See leading article, and discussion at Pharmaceutical meeting. We shall endeavour to obtain the formula.

C. W.—Evaporate at least a quart of the water, and acidulate very slightly with hydrochloric acid. Then pass sulphuretted hydrogen, and if there be no discoloration you may be sure of the absence of lead. Any other metal precipitable in the above way would probably be present in very minute proportion, and it would be necessary to operate on a much larger quantity.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

THE CHEMICAL NEWS.

VOL. VI. No. 155.—November 22, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Note on the Preparation of Perchloride of Iron.

THE property which a solution of sesquichloride of iron possesses of dissolving a large quantity of recently-precipitated peroxide of iron, should be borne in mind in preparing the solution of this salt for use as a test. A. Normandy, in his "Dictionary to the Chemical Atlas," gives instructions for preparing this reagent. He directs us to add the recently-precipitated and well-washed peroxide of iron to hydrochloric acid diluted with about six times its bulk of water, until the acid is completely saturated, which, he says, is known to be the case when the last portions of peroxide added refuse to dissolve even by continued boiling. The solution is then to be filtered. If these directions are strictly adhered to, a fluid will be obtained which is quite unfit for the purposes of the analyst, in consequence of its containing a considerable excess of peroxide of iron. It will be found to possess an intense red colour, and may be boiled or diluted without suffering decomposition.

The usual tests for iron in the state of persalt, on being applied to the solution diluted with fifteen or twenty times its bulk of water, will be found to yield very anomalous results, as shown below.

Yellow Prussiate of Potash.—Green precipitate or colour. Blue colour developed on adding hydrochloric acid.

Sulphocyanide of Potassium. — No blood-red colour, or very slight, and disappears on shaking the vessel. Ochreous precipitate.

Infusion of Galls.—Brown precipitate. Hydrochloric acid produces an ochreous precipitate when added to the solution; so does chloride of sodium, and other salts, produce the same effect. When the solution is added to acetate of soda, either pure or mixed with a little hydrochloric acid, a precipitate is formed at the ordinary temperature,—a property which renders the fluid unfit for use as a test for phosphoric acid.

D. L.

Falmouth, Jamaica.

On Hypobromous Acid, by JOHN SPILLER, *F.C.S.*

THE fact, that bromine furnishes, with nitrate of silver, products precisely analogous to those obtained by the action of chlorine upon an aqueous solution of this metallic salt, may be adduced as a conclusive proof of the existence of an oxide of bromine corresponding to hypochlorous acid. It was this reaction which enabled me, three years ago, to prepare and study the properties of the new bromine compound, and by the results of its examination I was induced to publish a "Note on the Existence of Hypobromous Acid" in the CHEMICAL NEWS of December 31, 1859. The short account then given fully explained its production, and established, by quantitative experiment, the truth of the following equation :—

$$Br_2 + AgO, NO_5 + HO = BrO + AgBr + HO, NO_5.$$

Having succeeded, also, in procuring hypobromous acid by the action of bromine water upon red oxide of mercury, and observed, in addition to the more obvious physical characters, its power of bleaching vegetable colours, I considered the proof of its existence satisfactorily established.

In addition to the information already recorded,* it may be desirable to note the following facts in reference to hypobromous acid :—

1st.—That this substance is formed when bromine is brought into contact with an aqueous solution of the nitrate of protoxide of mercury; but, inasmuch as the bromide of mercury is soluble to a considerable extent in solutions of the first-named salt, there is no immediate precipitate formed, as in the corresponding reaction between bromine and nitrate of silver.

2nd.—A further illustration of the different action of the metals, mercury and silver, may be noticed in the behaviour of their oxides when brought into contact with hypobromous acid. It is easy to prepare this acid by the action of bromine water upon the red oxide of mercury; but the product is itself as readily decomposed by contact with the oxide of silver.

3rd.—That the salts of lead and of the suboxide of mercury are incapable of effecting the oxidation of bromine.

The interesting particulars lately furnished by Mr. Dancer, of Manchester, in reference to hypobromous acid, which formed the subject of a communication to the Chemical Society on the 6th inst., may not only be said to have corroborated my earlier results, but, apparently, to have exhausted the whole subject.

Royal Arsenal, Woolwich, November 17, 1862.

TECHNICAL CHEMISTRY.

On the Theory of the Preparation of Soda by Le Blanc's Process,† by M. A. SCHEURER-KESTNER.

ALTHOUGH the proportions of sulphate of soda, chalk and charcoal, laid down by Le Blanc, for the preparation of soda, have remained unaltered for seventy years, the theory of the transformation of sulphate of soda into carbonate has not yet been positively established. Several chemists have, however, been occupied with this subject; and exact analyses of the products obtained

* *Vide* CHEMICAL NEWS, vol. i. p. 38; and vol. vi. p. 249.

† Besides the authors quoted in this *résumé*, we ought to mention the following, as having treated this same question :—Knapp, *Ehrbuch*, vol. i. p. 232; Schubarth, *Technische Chemie* (article "Soda"); Muspratt, *Technische Chemie*, vol. iii. p. 1432.

have been made, without any decided theoretical results. Proof of this assertion may be found in reading the treatises on this subject. Each has its theory, which the authors strive to support by new experiments. It is with the theory of the manufacture of soda, as with that of ultramarine blue—industry has stolen a march on science. Le Blanc, it is true, was guided by certain theoretical ideas—by certain analogies; but it was only by successive tentative experiments that he arrived at the result he foresaw.

The following are the proportions indicated by Le Blanc:—

Sulphate of soda	100
Carbonate of lime	100
Charcoal	50

The proportions of chalk used to 100 parts of sulphate of soda generally vary from 90·2 to 121 parts; of charcoal, from 40·3 to 73 parts. These numbers are taken from the following table, showing the quantities used in ten different manufactories, French, English, and German:—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	
Sulphate of soda.	100	100	100	100	100	100	100	100	100	100
Chalk	107·7	110	103	97·5	115	121	115	93 6	100	90·2
Charcoal	73	50	61·7	55·6	35	46·6	68	40·4	40·3	42·1

It will be observed that, in general, Le Blanc's quantities have been adopted, with the exception of slight differences, which may be attributed to the nature of the materials employed.

To appreciate the proportions of carbon, it is necessary to know the chemical composition of the charcoals employed. Some manufacturers use anthracite coals containing as much as 80 per cent. of coke, and yielding very little ash (4 to 5 per cent.); others, on the contrary, use coals containing only about 60 per cent. of coke, and giving by incineration 10, 15, and even 18 per cent. of ash. Between two similar quantities of coal, the difference may thus be as much as 20, or even 30 per cent. of carbon, more or less, putting aside the hydrocarbons as reducing bodies.

Taking account only of the proportions of sulphate of soda and chalk, and admitting 50·7 as the amount of pure carbon added to the sulphate of soda, the preceding proportions will be found comprised between the two following terms:—

(1) $3NaOSO_3 + 4CaOCO_2 + 18C$, and
(2) $NaOSO_3 + 3CaOCO_2 + 12C$.

The term (1) requires 71·4 of carbonate of lime, and the term (2) 107·2 of the same body, to 100 of sulphate of soda.

M. Dumas‡ was the first to advance a theory of the manufacture of soda. According to him, double decomposition takes place between sulphate of soda and carbonate of lime, forming carbonate of soda and sulphate of lime. But when dissolved in water, these two salts re-combine, and the charcoal introduced into the mixture has the effect of reducing the sulphate of lime into sulphide of calcium. With the preconceived idea, that the sulphide of calcium and carbonate of soda thus formed could not exist simultaneously on contact with water, M. Dumas supposed the formation of an insoluble compound of sulphide of calcium and lime—

$$2CaS.CaO,$$

necessitating the addition of excess of carbonate of lime to the mixture. The reaction is represented by M. Dumas in the following manner:—

$$2NaOSO_3 + 3CaOCO_2 + 12C = 2NaOCO_2 + \underbrace{CaO.\ 2CaS}_{} + 10CO + 3C.$$

‡ *Traité de Chimie*, vol. ii. p. 490.

M. Unger,§ in a long and interesting work, tries to prove that the reaction is not so simple as M. Dumas supposed. He admits, with the French chemist, the formation of an oxisulphide of calcium, but he attributes to it a different composition.

Taking, as a starting-point, M. Rose's discovery of an oxisulphide of barium, BaO. 3 BaS, and the analogies of calcium and barium, he admits an analogous composition for oxisulphide of calcium, and represents it by the formula—

$$3CaS.CaO.$$

By introducing this body into the composition of rough soda, it becomes necessary to have recourse to term (1), which, by M. Dumas' theory, gives the equation—

$$3NaOSO_3 + 4CaOCO_2 + 18C = 3NaOCO_2 + CaO.3CaS + 14CO + 5C.$$

But, according to M. Unger, the reaction is much more complicated. Sulphide of sodium and caustic lime are first formed (the carbonate of lime decomposing by the heat). These two bodies, reacting on each other, are transformed into oxisulphide of calcium and caustic soda. The caustic soda takes possession of the carbonic acid proceeding from the furnace, and from the combustion of the carbon contained in the mixture—

$$\begin{aligned} &3NaOSO_3 + 4CaOCO_2 + 19C \\ &= 3NaS + 4CaOCO_2 + 7C + 12CO \\ &= 3NaS + 4CaO + 3C + 20CO \\ &= 3NaO + CaO.3CaS + 3C + 20CO \\ &= 3NaOCO_2 + CaO.3CaS + 20CO. \end{aligned}$$

M. Unger‖ afterwards modified his view, and attributed great importance to the humidity of the coal and the water vapour formed by the combustion of hydrocarbons. He founds his opinion on the following facts:—

1. Sulphate of lime, made red-hot, and submitted to a hydrogen current, is transformed into sulphide of calcium and water—

$$CaOSO_3 + H_4 = CaS + 4HO.$$

2. The sulphide of calcium thus formed, is transformable, at red heat, by water vapour, into lime and hydrosulphic acid—

$$CaS + HO = CaO + HS.$$

3. Sulphate of soda is partially decomposable, at red heat, by carbonate of lime.

Starting from these data, the author believes that, in the preparation of rough soda, about one-third of sulphate of soda is decomposed into carbonate of soda by carbonate of lime, the remaining sulphate being transformed into sulphide of sodium. Sulphide of sodium reacting on carbonate of lime, transforms it into sulphide of calcium, which comes in contact with the hydrogen formed by the decomposition of the water contained in the materials, and formed by the combustion of the hydrocarbons. This sulphide is transformed into oxisulphide, losing one-fourth of its sulphur as hydrosulphic acid. The hydrosulphic acid combines with the caustic soda or carbonate of soda formed; and the sulphide of sodium, again in presence of the carbonate of lime, undergoes the same decomposition as above.

It will be perceived that water vapour plays an important part in the very complex reaction adopted by M. Unger.

An English chemist, Mr. Brown,¶ suggests a much simpler reaction. According to him, sulphide of sodium

§ *Annalen der Chemie und Pharmacie*, vol. lxi. p. 129; lxiii. p. 240; lxvii. p. 78; lxxxi. 289.

‖ *Annalen der Chemie und Pharmacie*, vol. lxxxi. p. 289.

¶ *Philosophical Magazine*, vol. xxxiv., p. 15.

is first formed, which is transformed into carbonate in the following manner:—

$$NaOSO_3 + 4C = NaS + 4CO$$
$$3NaS + 4CaOCO_2 = 3NaOCO_2 + CaO.3CaS + CO_2,$$

an equation corresponding to the term (1).

M. Kynaston* has recently investigated this subject, and has arrived at different conclusions. He says that the existence of oxisulphide of calcium is a pure hypothesis, and he tries to ascertain whether sulphide of calcium is less soluble in water when lime is present, and, if so, wherefore.

By leaving rough soda for some time in contact with water, all the lime of the so-called oxisulphide of calcium is transformed into carbonate of lime. The author believes that in this case an insoluble combination of sulphide of calcium and carbonate of lime is formed, provided that the sulphide of calcium is not decomposed. To this insoluble compound he gives the formula—

$$CaOCO_2.2CaS.$$

Solutions of rough soda contain all the caustic soda, which can proceed only from the decomposition of the carbonate of soda by the lime, which has been considered as forming part of an oxisulphide.

Most chemists have admitted the presence of caustic soda in rough soda; and that this caustic soda is, partially or wholly, transformed into carbonate by the gases proceeding from the combustion.

But, says M. Kynaston, this supposition is inadmissible, for, by melting a mixture of caustic soda and carbonate of lime, carbonate of soda and caustic lime are formed. These two bodies, when in solution, decompose mutually and inversely. Moreover, caustic lime and sulphide of sodium are formed by the fusion of caustic soda, mixed with sulphide of calcium, a reaction which is again reversed by contact with water. Now, it is not probable that, in the preparation of soda, these reactions should take place in the same manner.

It is true that, in the preparation of rough soda, carbonate of lime may be replaced by caustic lime, as has, indeed, been done in various manufactories; but M. Kynaston urges that, in this instance, the charcoal induces a special reaction. The fusion of a mixture of sulphate of soda and caustic lime does not provoke double decomposition. In presence of carbon, on the contrary, or, rather, of the carbonic acid formed at the expense of the carbon, decomposition takes place by reason of the affinity of caustic soda for carbonic acid; moreover, water is not decomposed by zinc, except in presence of sulphuric acid.

Every chemist who admits the existence of caustic soda in rough, finds carbonate of lime in the residuum of the treatment of soda by water. But it is impossible that carbonate of lime should resist the action of caustic soda during the action of the heat, when these two bodies decompose mutually at a much lower temperature than that necessary for the fusion of soda.

According to M. Dumas' theory, rough soda cannot contain caustic soda; for, during the first phase of the operation, carbonate of soda and sulphate of lime are formed, and it is the latter which the charcoal reduces.

From the moment the rough soda contains no caustic soda, it is impossible, says M. Kynaston, to suppose the existence of an insoluble compound of oxisulphide, because water decomposes these bodies into carbonate of lime and caustic soda.

The presence of small quantities of sulphides in the washings of rough soda, is accounted for, says the author, by the presence of small quantities of bisulphide of calcium, CaS_2, or of hydrosulphate of sulphide of calcium, CaSHS, which body is easily formed. To avoid the presence of sulphide of sodium, it is necessary to prevent the formation of these polysulphides.

The sulphites and hyposulphites found in the washings are formed by the action of air on the still warm soda.

In the following table are united the analyses made by different authors:—

	Unger.		Brown.	Richardson.	Murphy.	Kynaston.	Stohmann.	
	1	2					1	2
Sulphate of soda	1·99	...	1·160	3·64	0·748	0·395	1·54	1·54
Sulphide of sodium	...	...	1·130	...	...	...	...	...
Chloride of sodium	2·54	0·4	1·913	0·60	1·308	2·528	1·42	1·75
Carbonate of soda	23·57	37·8	35·640	9·89	41·469	36·879	44·41	38·45
Silicate of soda	...	...	...	...	1·162	1·182	...	...
Hydrated caustic soda	11·12	...	...	25·64	...	...	...	3·17
Anhydrous caustic soda	...	1·6	0·609	...	...	...	...	...
Aluminate of soda	...	...	2·350	...	0·392	0·689	...	...
Carbonate of lime	12·90	...	...	...	0·857	3·315	3·20	...
Oxisulphide 3CaS, CaO	34·76	40·0	29·172	35·57	...	...	38·98	36·91
Sulphite of lime	...	...	...	...	...	2·178	...	...
Hyposulphite of lime	...	...	...	...	...	1·152	...	...
Sulphide of calcium	...	...	...	...	33·193	28·681	...	...
Bisulphide of calcium	...	...	...	...	...	0·435	...	...
Lime	...	8·5	6·301	...	9·320	9·270	0·33	0·61
Magnesia	...	0·8	...	...	...	0·254	0·10	0·51
Sulphate of magnesia	...	...	3·744	...	...	...	...	...
Silicate of magnesia	4·74	...	...	0·88	...	...	...	...
Alumina	...	1·2	...	...	1·020	1·132	0·79	...
Water	2·10	...	0·700	2·17	...	0·219	...	6·71
Ferric oxide	...	...	...	...	3·020	2·658	1·75	2·40
Sulphide of iron	2·45	1·2	4·917	1·22	...	0·371	...	...
Silica	...	5·0	...	...	...	...	0·89	1·36
Sand	2·02	...	4·285	0·44	2·259	0·901	2·20	1·16
Charcoal	1·59	2·6	7·998	4·28	4·724	7·007	5·32	5·43
Ultramarine	...	...	0·295	...	...	0·959	...	...

* *The Chemist*, 1860; and *Repertoire de Chimie Appliquée*, 1861.

We have seen that the idea of the existence of an insoluble oxisulphide of calcium, suggested by M. Dumas, was introduced for the purpose of explaining why, in solutions of rough soda, double decomposition does not take place between the sulphide of calcium and carbonate of soda; but this oxisulphide has not as yet been isolated. It is a hypothetical body, to which M. Dumas has given the formula

$$2CaS.CaO,$$

obtained by means of the term (2).

M. Unger has changed the formula of this body to

$$3CaS.CaO,$$

because M. Rose has isolated a barytic salt with this composition. I do not understand why the formula $2CaS.CaO$ should be rejected directly the possibility of the existence of the body $3CaS.CaO$ is admitted, as that body has not yet been obtained. In the second place, to establish the formula

$$3CaS.CaO,$$

we must have recourse to term (2), which differs much more than term (1) from the proportions used in preparing soda.

M. Kynaston, founding his theory on the decomposing effect of water on carbonate of soda and lime, rejects the idea of an insoluble oxisulphide, and admits the formation of an insoluble compound of sulphide of calcium and carbonate of lime,

$$2CaS.CaOCO_2.$$

This itself is a new hypothesis, and is quite as problematical as the existence of an insoluble oxisulphide.

M. Unger attributes great influence to the water vapour proceeding from the humidity of the matters employed, and from the combustion of the hydrocarbons. But it is to be observed that it is possible to prepare rough soda first with perfectly dry materials, and in a hermetically sealed crucible; that is to say, kept apart from the products of the combustion. The gases produced by the flame are not then necessary for the formation of carbonate of soda.

As to the presence of caustic soda in rough soda, it appears to me quite inadmissible, for the reasons given by M. Kynaston, and because it would be necessary to admit the existence of this anhydrous product in soda. I have never succeeded in finding hydrated caustic soda in any specimen of rough soda. In fact, when treated by alcohol, it yields nothing to that solvent.

If the carbonic acid, combined with the soda, proceeded only from the gases of combustion, rough soda prepared apart from these gases would contain only caustic soda and no carbonate, and this would be contrary to all experience.

M. Kynaston rejects the existence of oxisulphide of calcium, because the solution of rough soda contains caustic soda, which could proceed only from the action of lime on carbonate of soda. The following experiments tend to support this opinion; but they show that, in proportion to the formation of caustic soda, sulphide of sodium is likewise produced when contact of the solution with the residuums is some time prolonged.

Solutions of pure carbonate of soda of different densities were mixed with some dregs of fresh soda, which had not undergone the action of the air. The caustic soda as well as the sulphide of sodium were determined each day, in order to follow the progress of the decomposition.

The numbers in the first column show the amount of caustic soda in proportion to 100 parts of carbonate of soda. Those in the second column have a relative value only; they represent the divisions of a graduated burette, containing a solution of iodine, by means of which the estimation was effected.

Liquid at 5° B.		Liquid at 10° B.		Liquid at 15° B.		Liquid at 20° B.	
Caustic Soda.	Sulphid of Sodium.	Caustic Soda.	Sulphid of Sodium.	Caustic Soda.	Sulphid of Sodium.	Caustic Soda.	Sulphid of Sodium.
9	44	14	90	20	67	21	59
11	69	12	136	13	147	23	120
20	74	13	171	13	206	20	162
11	108	8	285	5	275	9	200
3	115	5	370	0	320	5	310
0	165	0	675	0	630	0	404

The experiment lasted seven days. The first analyses were made after twenty-four hours interval.

Were there an oxisulphide of calcium—in other words, could lime combine chemically with sulphide of calcium, it would follow that, by the slow decomposition of this oxisulphide, the sulphide of sodium would augment in proportion to the caustic soda, while the accompanying table proves the contrary. The carbonate of soda is first decomposed by lime; sulphide of sodium is formed simultaneously with caustic soda, but in very different proportions; moreover, it will be remarked, that lime more promptly decomposes carbonate of soda with strong than with diluted liquids. For the first three days the proportions of sulphide of sodium formed to 100 parts of caustic soda were as follow:—

	Liquids at 5° B.	Liquids 10° B.	Liquids 15° B.	Liquids 20° B.
First day	489	642	335	280
Second day	627	1133	1130	521
Third day	370	1316	1584	810

By the third day the causticity diminished, because the solution then contained only caustic soda and sulphide of sodium, and no more carbonate of soda. The caustic soda acted in its turn on the sulphide of calcium, and was transformed into sulphide of sodium; after a short time there remained a solution of pure sulphide of sodium, containing neither carbonate of soda, nor caustic soda, on condition, of course, that the operation is conducted on an excess of residuum of soda.

The following equations represent the different phases of the reaction:—

$$CaO + NaOCO_2 = CaOCO_2 + (NaO)_A$$
$$(NaO)_A + CaS = NaS + (CaO)_B$$
$$NaOCO_2 + (CaO)_B = CaOCO_2 + (NaO)_C$$
$$CaS + (NaO)_C = (CaO)_D + NaS. \quad . \quad . \quad .$$

The reaction goes on until carbonate of soda ceases to exist. This fact shows that there is no combination whatever between the lime and the sulphide of calcium, unless the causticity and the sulphuration of the liquids should augment simultaneously. M. Kynaston arrived at the same result in considering only the causticity of the solutions; he admits the formation of an insoluble compound of carbonate of lime and sulphide of calcium, a compound as yet hypothetical; but the preceding experiments show that the presence of bisulphide of calcium in rough soda is not necessary to explain that of sulphide of sodium in the liquids. And it is evident how important it is to conduct the washing of the soda as quickly as possible.

M. Mohr has analysed a liquid proceeding from the lixiviation of soda from a German factory.

The liquid was completely saturated; it contained sulphuric acid, cyanides, chlorides, alumina, hydrosulphuric acid, hyposulphurous acid, and silicic acid. Its density was $1{\cdot}25\ 26 = 30°$ B.

Evaporated in presence of carbonate of ammonia it produced 31 gr. 9 of solid salts, or 24·98 per cent.

Caustic soda was determined by chloride of barium, chlorine by nitrate of silver, sulphides and hyposulphites by iodine.

The results obtained, reduced to per centages, were as follow :—

Carbonate of soda	71·25
Soda	24·50
Chloride of sodium	1·85
Sulphite of sodium	0·10
Hyposulphite	0·37
Sulphide of sodium	0·23
Cyanide of sodium	0·09
Alumina	1·51
Silica	0·17
Sulphide of iron	traces
	100·20

Finally, MM. Brown and Unger have given analyses of dregs of soda :—

	Brown.	Unger.
Carbonate of lime	24·22	19·56
Oxisulphide of calcium	20·36	32·80
Sulphate of lime	4·28	,,
Sulphite of lime	,,	3·69
Hyposulphite of lime	traces	4·12
Hydrate of lime	5·56	10·69
Bisulphide of calcium	3·58	4·67
Sulphide of calcium	8·53	3·25
Sulphide of sodium	,,	1·78
Carbonate of soda	1·31	,,
Ferric oxide	5·71	3·70
Silicate of magnesia	5·98	6·91
Carbon	12·70	2·60
Sand	5·74	3·09
Water	2·10	3·45
	100·07	100·31

The presence of excess of caustic lime in the residuums of the soda is accounted for by the manner in which the reaction takes place between the liquid and the residuums. It is well known that it is impossible to obtain caustic soda with strong liquids. It is not, then, surprising that the larger portion of the carbonate of soda escapes the action of the caustic lime.

It has long been remarked that, with a given quantity of sulphate of soda, the corresponding quantity of carbonate is not produced; the yield varies with the nature of the first materials used, and with the temperature of the fusion. When the first materials are rich in silica and alumina, alkaline silicates, very slightly soluble, are formed, which remain in the residuum after the washing of the rough soda.

M. Stromeyer (*Annalen der Chemie und Pharmacie*, vol. cvii. p. 121) has proved that, when soda is fused at too high a temperature, a portion of the soda is reduced and volatilised in the state of sodium, the loss may even be as great as 3 per cent. of the sulphate employed.

To conclude, M. Unger's theory to us seems quite inadmissible, because it necessitates the concurrence of the combustion gases, an assertion contradicted by experiments. The presence of caustic soda in rough soda appears to us impossible. As to the existence of insoluble compounds of sulphide of calcium and lime, or of sulphide of calcium and carbonate of lime, it seems to be disproved by facts, at least with respect to the first compound. The combination of sulphide of calcium and carbonate of lime has never been isolated, but this, as yet, is the only hypothesis which agrees with the observed facts. To clear up this point, it would be necessary to compare the action of a solution of carbonate of soda on pure sulphide of calcium; and this same sulphide, mixed with excess of caustic lime, is to be previously heated to redness with lime.

One fact seems to support M. Dumas' theory, namely, the decomposition of carbonate of lime by sulphate of soda, and the ulterior reduction of the sulphate of lime formed. In cakes of rough soda are often found white morsels of limestone, which have escaped a part of the reaction, and which are formed of sulphide of calcium and caustic lime.—*Repertoire de Chimie Pure et Appliquée.*

*On the Prevention of Decay in Timber for Ship-Building and Other Purposes.**

(*Concluded from page 247.*)

The causes and the development of decay in timber having been stated, the nature of the remedies, preventive or repressive, may be enumerated in the following order :—

1st. By disturbing the stagnation of air in the channels or space and room of the timbers.

2nd. By getting rid of the confined air in contact with the timber.

3rd. By preparing the surface of timber in such a manner as to prevent the engendering and growth of fungi.

4th. By impregnating the air in contact with the timber with a substance destructive to the sporules of the fungi.

It is a common error in building the hull of a ship to isolate the channels, and cut off their communication with the outer air—a bad practice, which must be abandoned. Formerly, they were sparing of bull's eyes in the lower decks; but though the want of light added to the dirt of the hold, the advantage of them in caulking the seams was found too great to allow their use to be altogether discarded.

A very simple plan, and one without any inconvenience, to bring all the air channels into communication, would be, at equal distances on the surface of the length of the ribs, to bore holes about three centimètres ($1\frac{1}{8}$ inch) in diameter, which would not materially weaken the main timbers, equally taking care to arrange the half circular channeling on the lateral surface of the bends which keep apart the ribs. By these precautions, the air confined in the channels would be continually renewed. Moreover, a quicker circulation in that air might be produced at any time by means of a small ventilator, similar to that used in mines, the handle of which would fit into one of the holes, all the others on the same side, one excepted, being shut. By these simple means, the air channels would be rendered wholesome, and the fermentation on the surfaces of the length of the ribs be prevented; but they would not be sufficient to freshen the little draughts of air confined between the planking and the ceiling, which are retained by friction, so that it would be necessary to use some other means to get rid of them. They now exist only because, timber having but little compressibility, the surfaces in contact cannot mould themselves, which it is indispensable they should do, exactly one upon the other; but this can be accomplished by interposing an elastic substance, such as India-rubber, either compressible like felt, or a cement like that of glaziers, but made with oil without driers, and mixed with a certain proportion of

* From an essay on the subject by M. de Lapparent, Inspector-General of Timber for the French Navy.

flour of sulphur. This last method the author thinks particularly worthy of trial.

But the most important plan is to prepare the surface of timber in such a way as to prevent fermentation, and to render the adherence and growth of fungi almost impossible. From time immemorial it has been the practice, particularly in the country, to burn the ends of poles driven into the ground, to preserve them from decay. According to the sage remark of the celebrated Carlomb, we should always take into serious consideration old and well-known customs; but, in this instance, it is easy to admit the preserving effect of carbonisation. In the first place, the surface of the timber is subjected to a considerable heat, the primary effect of which is to exhaust the sap of the epidermis, and to dry up the fermenting principles—here this is done by long exposure to the air; and, in the second place, below the outside layer, completely carbonised, a scorched surface is found, that is to say, partly distilled and impregnated with the products of that distillation, which are creosoted and empyreumatic, the antiseptic properties of which are well known.

The author mentions instances of carbonised wood having been remarkably preserved for long periods under unfavourable circumstances, and observes that he was convinced by all these facts that the carbonisation of the timbers of ships would materially increase their durability; but that conviction was changed to certainty when he met with an article entitled "Seasoning of Timber," extracted from "The Architectural Navy," a work published in London in 1852. The writer, having noticed the numerous methods tried in the beginning of the eighteenth century to increase the durability of timber for building purposes, adds, that "not long after this time the method of heating or charring timber, before it was worked up, and also that of stoving, that is, of heating it in kilns with sand, was practised in the Royal dockyards. The *Royal William*, one of the most remarkable instances of durability that the British navy has supplied, was built either wholly or in part of timber that had been charred."

The author asks, why has this excellent method not only not been persevered in, but even abandoned? This is owing to many causes: the difficulty and danger of the means adopted for charring, when either straw, fern, or shavings are made use of; the serious objections of burning the timber too deeply; or the incumbrance of the apparatus, and the length of the time occupied, if sand-kilns sufficiently heated are used; and, finally, to indifference, or that system of routine against which the wisest plans so often contend in vain.

The methods of carbonisation which the author first employed at Cherbourg, and which, by the order of the Minister of Marine, are about to be extended to all the dockyards of the French empire, are free from these objections, and realise, on the contrary, all the conditions to be desired, whether of simplicity, facility, safety, or economy. They are as follows:—

A gaspipe is brought into the dockyard. An India-rubber tube is screwed on, the other end of which, furnished with a joint, should be fixed at the side of the bench at which the men work. To this joint another end of a tube of sufficient length is fixed, and on that a little brass end is placed, similar to that of a fire-pump, but having inside a small pipe communicating with the reservoir of a foot bellows on the bench. The object of this bellows is, first, to mix with the gas the air necessary to obtain a complete combustion; and, in the second place, to impinge on the jet of flame such a force that it may be directed every way, and made to act not only on the surface of the wood, but in the holes, joints, bolts, mortices, &c., and in general on every part of the timber. The combustion takes place with the most perfect regularity, and, as can be proved, without the least danger, which, be it understood, does not exclude the precautions commonly prudent to adopt whenever fire is employed either on shipboard or in the dockyard.

The results obtained from experiments at the gasometer at Cherbourg, with the aid of a meter, and using a jet of average force, are—

1st. That the consumption of gas would be about 200 litres per square mètre, or 200 gallons per 10 square feet of carbonised surface.

2nd. That a workman, in an average day's work of 10 hours, would carbonise a surface of 40 square mètres, or 440 square feet.

3rd. That one workman is sufficient for a bellows supplying two jets of gas.

It may, therefore, be admitted that, at full work, the expense would not exceed 15 centimes (1½d.) a square mètre, or 10 square feet. Besides, as has been ascertained by experiment, the operation can be facilitated by smearing, in the first instance, the surface of the timber with a little tar. By so doing these other advantages are gained—

1st. The carbonisation of the cracks, that almost always occur on the surface of rough timber, is facilitated.

2nd. It prevents the timber being affected too suddenly by the heat of the gas, which causes it to split.

3rd. It prevents the cracking and splintering off of little ignited particles.

But beyond a mere facing of tar we must not go; a little thicker layer would impede, instead of furthering, the operation. Besides, we must stop as soon as the surface is freely carbonised, which shows that none of the parts below have escaped the charring—which is, I repeat, the end we seek. Under these circumstances, the depth carbonised will not exceed a third, or a fourth, of a millimètre. In ship-building, the carbonising process ought to be applied to every surface in contact with, or, in general, intended to be surrounded by, moist and stagnant air.*

Moreover, it will be advantageously employed in the graving docks and slips, from the facility afforded in drying and hardening those parts of the hull intended to be preserved, and in destroying the fermentation which will be found there.

In house building, the process should be applied to the beams and joists embedded in the walls, or surrounded with plaster; to the joists of stables, cowhouses, washhouses, &c., which, although exposed to the free air, are constantly surrounded by a warm and moist atmosphere, an active cause of fermentation; to the wainscoting of ground floors; to the flooring beneath the parquet work; to the joints of tongues and rabbets, &c.; for carbonisation by means of gas still leaves to the wood, for working purposes, all the sharpness of its edges.

By carbonisation a practical and economical means is offered to railway companies of preserving, almost for ever, the sleepers, particularly oak, which cannot be impregnated by the injection of sulphate of copper. Let us suppose, for instance, that after, say ten or fifteen years, the sleepers on a line are taken up for the length of a mile, and replaced by new ones, the old, when

* Thus, as regards cased or cuirassed frigates, the external as well as the internal surfaces of the planking, on which the iron plates are fixed, should be carbonised.

rasped and burnt again, will serve for the replacing of the following mile, and so on, one mile after the other.

With regard to vine-props and hop-poles, carbonisation offers very great advantages, in an economic point of view, by its cheap and practical method of operation.

As to the different methods of carbonisation; when the timber-yard where the work is to be carried on is in the neighbourhood of a gas main, nothing can be easier than to lead it close to the work by a conducting tube, joining a little gasometer by which the issue is regulated.

If the expense of laying down the pipe is very heavy, compressed portable gas, like that distributed daily in Paris, as in many adjoining localities, can be used. The Imperial Marine adopt that plan, not only because their workshops are not lighted with gas, but, even if they had it, they prefer being able to carbonise certain parts of a vessel when afloat, for which it is sufficient to place on a boat or floating stage, moored alongside, a vessel charged with compressed gas; a regulator is put in communication with this, which allows the issue according to the pressure of the current of gas, or, in general, to such pressure as may be required.

In the place of coal gas, the cost of which is very great, carbonic oxide gas may be advantageously employed; for while, on the one hand, its illuminating power is very weak, its heating power, on the other, is very great.

Knowing the preservative effects of sulphur, the author was induced to try a species of paint, using flour of sulphur as a basis, and linseed oil as an amalgamator.†

We know that when paint dries, to use a common expression, it is not by evaporation similar to that which water undergoes, but rather from the effect of a real combustion of the oil by the oxygen of the air, the result of which is a kind of solid resin; and it appeared to the author probable that the sulphur, having itself a great affinity for oxygen, would participate in that combustion from which would be generated sulphuric acid. These anticipations were fully realised. The planks painted for experiment emitted sulphurous vapours, and turned to red some strips of litmus paper previously moistened and subjected to the exhalations. Some logs of oak, painted in the same way, were buried in a dung-heap; six months afterwards the wood appeared perfectly intact, and exhaled a strong sulphurous odour, the action of which had, without doubt, prevented the formation of fungi.

It, therefore, appears proved that, by smearing here and there either the surfaces of the length of the ribs or below the ceiling with this paint, a slightly sulphurous atmosphere will be developed in the hold, which will purify the air by destroying, at least in part, the sporules of the fungi.

This conclusion will be so much the more valuable, as it appears to be arrived at from the recent and curious experiments of M. Pastoreau, which, by depriving of air the sporules he had enclosed, annihilated their fermenting powers.

With regard to the carbonisation of timber, it may be stated, that, after having scraped the carbonised or charred layer, and pumiced the surface of the wood, it may be painted in the usual way, and with any colour.

† The paint is composed of—

Flour of sulphur	3088 grains
Common linseed oil	2084 ,,
Prepared oil of manganese	463 ,,

PHARMACY, TOXICOLOGY, &c.

Formula for the Administration of Sarracenia Purpurea, by Charles R. C. Tichborne, *Esq.*

It is desirable that we should possess such a mode of preparing each medicament that it should combine the thorough extraction and preservation of its active principle, and also place it in our hands in an available form for administration. Some time ago, I wished to prepare the tincture of sarracenia, and, after looking over the researches on the subject, and also making several inquiries, I found that there were no published formulæ, except one, in the form of an infusion.* The largeness of the dose prevents the employment of the ordinary proof spirit in the making of a tincture, particularly as it would not be desirable to exhibit such large doses of alcohol in the disease in which it is said to be a specific. Under these circumstances, and as there seems to be some interest excited, I have no hesitation in suggesting the following formula, so as to place it in the hands of the medical profession in a convenient form, and that its reputed virtues as a specific in small-pox, &c., may be put to the test. I shall not touch upon the physical, chemical, or therapeutical properties of the plant, but I may as well state, *en passant*, that from experiments upon myself, the results, either from the administration of the roots or leaves, seem identical in connection with their action upon the kidneys. The following formula is constructed, presuming that the average dose is about ʒjss.; but if from experience it be found desirable to alter it, it will be only necessary to bear in mind that each fluid ʒss. represents ʒj. of the sarracenia. As the leaves form curiously tube-shaped cups, they become regular fly-traps; and it will perhaps be as well that they be torn open, and the dirt and fragments of flies which will be found in them be sifted out before powdering:—

Take—Purple sarracenia, ʒv.; water, a sufficient quantity; rectified spirits of wine, ʒijss.

Coarsely powder the sarracenia, and pass it through a sieve the meshes of which are about one hundred and sixty to the square inch, moisten it with a little water, and pack lightly into a displacement apparatus, allowing water to percolate through as long as any amount of extractive matter is withdrawn. Evaporate this upon a water-bath to about fifteen ounces, add the spirit when cold, and sufficient water to make the whole measure one pint. The dose of this tincture or liquor will be from ʒss. to ʒvj., copiously diluted with water. Many who have received benefit from its administration are most sanguine as regards its efficacy; and as the active principle is soluble in cold water, I think the above preparation will give it a fair trial. I do not think it probable that we shall have to ask, with Horace,

"Amphora cœpit
"Institui; currente rotâ cur urceus exit."

The tincture will be found to keep, although the spirit will be about 82 per cent. under proof.

Dublin, November 5, 1862.

PHYSICAL SCIENCE.

On the Spectra of Electric Light as modified by the Nature of the Electrodes and the Media of Discharge, by the Rev. T. R. Robinson, *D.D., F.R.S.*

The author, after referring briefly to the researches of previous inquirers, and the hypothesis now generally

* F. Morris, M.D., in the *American Medical Times*.

adopted, that the bright lines observed in these spectra depend so absolutely on the chemical nature of the substances present, that their occurrence is an unerring test of that presence, expresses his belief that it cannot be admitted in its full extent without much more decisive proof than has yet been afforded. It assumes—

1. That each substance has a set of lines peculiar to itself.

2. That those lines are not produced or modified by any molecular agent except heat.

3. That the spectrum of one substance is in nowise modified by the presence of another; and in such cases, both spectra co-exist independently, and are merely superposed.

4. As may be inferred from 2, that electricity does not make matter luminous directly, but only by heating it, so that the electric spectrum differs in nothing from that produced by heat of sufficient intensity.

His attention was directed to this subject several years ago by the difference of colour of discharges in carbonic oxide at common and diminished pressure; and the results of his experiments appear to show that none of these four points is universally true.

His apparatus consisted of a powerful induction machine, with which a Leyden jar was connected; of prisms, first one of 45°, afterwards one of 60° (whose deviations were reduced to the scale of the first); and of an optical theodolite, in which a collimator with a variable slit gives the beam whose spectrum is observed. He points out an important defect of this arrangement, and discusses the probable liabilities to error proceeding from the graduation reading only to minutes, and from other sources of uncertainty.

The media of discharge were air, nitrogen, oxygen, hydrogen, and carbonic oxide, to which were added, in some instances, the vapours of mercury, phosphorus, and bisulphuret of carbon. For electrodes, 23 metals and graphite were used—15 with each of the five gases at common pressure, and at one of 0°·2, the others only with some of them. In all, 185 different spectra were measured, of which 93 were at common pressure.

At common pressure the spectra show a number of bright lines on a coloured ground, the light of which is in general stronger towards the red than the violet end, and strongest in the green. In some this ground is so bright as to efface all but the most luminous lines. This is especially the case with hydrogen. Of the lines, some are very brilliant, but they range in light down to the very lowest degree of faintness, such that (at least, with the author's apparatus) they can only be seen when the room is entirely dark, and are bisected with great difficulty. They vary also in width, from a mere hair's breadth to six or seven times the apparent width of the slit.

On exhausting the tube in which the discharge is made, at first the only change is, that the brilliant lines lose a little of their lustre, till at pressures varying from 3° to 0°·5 the spectrum rather suddenly fades away, sometimes leaving only a suspicion of one or two lines; with others, the least refrangible rays vanish, while the violet remain, though very faint, especially with aluminium. In hydrogen spectra the three bright bands of this gas vanish at unequal densities, and it is remarkable that this occurs when the gas is diluted to the same proportions by mixing air with it.

Exhausting yet further, this transition spectrum becomes again bright. Fresh lines appear, and it is changed into a new one, which, however, is never as splendid as that at common pressure, especially at the red end, and in which the very brilliant lines are less frequent. This want makes the difference between the two kinds of spectra seem greater than it really is. Fewer lines are visible in the rarefied media, and of these about four-tenths are not found in the spectra of common pressure.

If the tables in which the measures are given be examined in reference to the points alluded to as doubtful, it will be obvious—

1. That many lines are found in all the gases, and in many, perhaps all, the metals. The existence of such lines must be independent of the chemical nature of electrodes or media. It is otherwise with their brightness, which may be intense with one substance and feeble with another. This unchemical origin is still more clearly shown by a modified experiment of Plücker, where the discharge is made by the induction of glass without the presence of any metal. When the same glass vessel was filled in succession with nitrogen, oxygen, and hydrogen, though not above 23 lines were seen in its capillary tube, and those very faint, yet more than half the number were common to two of the gases, or to the three. These might, perhaps, be referred to soda or lead detached from the glass; but some of them are not found in those spectra.

2. The difference between the common pressure, transition, and rarefied spectrum shows that the character, and even the existence, of certain lines depend on the mere density of the medium, the chemical circumstances remaining unchanged.

3. That the spectra are not merely superposed without change is evident from several facts. The spectra of air do not in every case show all the lines of oxygen and nitrogen, and occasionally have some not visible in either of them. The spectrum of graphite in oxygen is quite different from those of carbonic oxide. There is even reason to believe, that for certain lines the actions of bodies may be antagonistic. The spectrum of mercury electrodes and mercury vapour showed 48 lines; and the author expected that the spectra for any gas with mercury electrodes would add to those of mercury the peculiar lines of that gas, which could thus be certainly determined. In the nitrogen spectrum, however, 20 of the mercurial lines had disappeared, in the hydrogen 18, and in the carbonic oxide 13.

4. The brilliancy or visibility of the lines is very little increased by greatly augmenting the heating power of the discharge. The two halves of the induction machine can be made to act, either consecutively for tension, or collaterally for quantity. In the latter case the quantity is doubled, and, therefore, the heating power quadrupled. When the apparatus is so used, the violet bands are something brighter, but not so much so as to be noticed by an unpractised observer. The red and green show no appreciable difference; but the author is inclined to think the change may be greater in the ultra-violet part. He proposes, however, to repeat the experiment with coils of much greater power as to quantity. If electricity can produce thermic vibrations by its transmission, there seems no *à priori* reason why it cannot produce luminous ones; and no evidence that it cannot is known to him.

It seems to follow, from these observations, that the tendency to show such lines belongs to matter in general, but that different forms of it have different powers of manifesting that tendency, and that those powers may sometimes interfere. If this be confirmed by further research, the result will be that, though the electric spectrum may give useful indications to the analyst, it

should never be his sole dependence, or be trusted without full cognisance of the conditions which may affect its indications.—*Proceedings of the Royal Society.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 4, 1862.

J. P. Joule, *LL.D., F.R.S., Vice-President, in the Chair.*

Mr. Peter Hart was elected an Ordinary Member of the Society.

Dr. Roberts exhibited some microscopic preparations illustrating the effect of a solution of magenta on the blood. The red blood-disks were tinted of a faint rose; and one portion of their outline, in a majority of the corpuscles, appeared more deeply tinted than the remainder. The pale corpuscles were more strongly tinted than the red; and their nuclei were displayed with great clearness, dyed of a magnificent carbuncle-red. A number of the nuclei were seen in the process of division, more or less advanced, and in some cells the partition had issued in the production of two, three, or four distinct secondary nuclei. There was evidence that these secondary nuclei were set free in the blood, and, by subsequent enlargement and change of form and chemical constitution, developed into red blood disks, which would, therefore, appear to be, as Mr. Wharton Jones first conceived, free cellæform nuclei, and not, according to the current belief, enlarged and altered pale corpuscles.

Mr. Dyer, Vice-President, exhibited a broken screw-bolt, 1¼ in. square (used to fasten a cart body to the axle). The fracture, near the head end, appeared very much like one of cast-iron; imbedded in the centre of the bar was a smooth, egg-shaped mass, about ¼ in. diameter, crossing the fracture, and leaving a cavity as its mould in the metal on one side. He assumed that faults like this were, probably, owing to the rapid processes in use for reducing masses from the puddle into bars of wrought iron, whilst the metal was only partially converted to the malleable state, as appeared in this sample of bad iron. The iron, in a semi-fluid state, is passed from the furnace through a succession of rollers, without reheating or faggoting, as was formerly practised, and at once reduced to the sizes required. The improved rolling mills could not, it seemed, insure improved qualities of wrought iron, whilst they afforded temptations to make it far inferior to any that could have been made fifty years ago. Considering the many hazards to which life and property are exposed in travelling by railway and otherwise, from the iron "shuffled off in haste," and found in use in engineering constructions, it becomes important that previous tests should be employed to ascertain the real nature of the iron, so as to leave no question of its being in a safe condition for the purpose intended, and not like this specimen, and like much now-a-days made by pressing the half-converted puddle into marketable shapes.

In connection with the subject of the slow changes which iron undergoes, M. Breguet, of Paris, stated that, in their furnace for preparing soft iron, he had observed a remarkable case of crystallisation of wrought iron. One of the furnace-bars became brittle, and, on breaking a portion of it, he found it to contain a large cubical crystal of iron, each of whose sides measured five millimetres in length. This singular specimen is now in the possession of M. Balard.

NOTICES OF BOOKS.

International Exhibition: Jurors' Reports: Class II. *Section* B. *Medical and Pharmaceutical Products and Processes.*

This Report is not altogether what we approve, nor what we expected, yet is not without its merits. It is not in any way an easy thing to write a paper of the kind which will please everybody. When all the exhibitors have done their best, and are expecting praise, if no other reward, there must be some dissatisfaction; and, perhaps, Mr. Hanbury has provoked as little as possible. Nevertheless, we hear of a good deal in connection with this particular report, some of which is not altogether without reason.

The duty of a jury appears to us to be of a very simple nature. There are the samples to be looked at, tasted, handled, analysed, and examined in every possible way; and all the jury has to do is, to say whether the articles are what they profess to be, and, if there be any difference, which is the best. Any other criticism appears to us uncalled for and out of place in a document like this Report, and, at most, should be subservient to that we have indicated. Yet this is just the criticism which Mr. Hanbury has omitted. We may illustrate this by his remarks on the numerous compounds of iron, and other bases, in the form of scale preparations:—

"In addition to the ferruginous preparations already mentioned, which are most of them well-known, and which one would think ought to fulfil every possible indication, we find a considerable number of which the introduction, or proposed introduction, is recent. We allude to such compounds as the following:—Citrate of iron and strychnia, citrate of iron and quinine, citrate of iron and quinidine, citrate of iron and cinchonine, citrate of iron and zinc, citrate of iron and manganese, lithio-citrate of iron, pyro-phosphate of iron and quinine, &c. These preparations, which emanate from various laboratories, are non-crystalline, but in the form of beautiful shining scales, an appearance so attractive that their really objectionable character is apt to be overlooked. When we consider the advantage of having chemical medicines of definite composition, and that this composition should be easily determinable, we think it will be seen that the use of compounds such as we have just enumerated should be strongly discouraged. *Citrate of iron and quinine*, although an elegant and now established medicine, is one which has been the object of so much sophistication that we are ready to think it were better if it had never been introduced. The absence of any authoritative formula for its preparation, and the practical difficulty of quickly and accurately determining its composition, together with an unscrupulous competition in price, have contributed to render it, as found in commerce, an extremely variable compound.

"The *citrate of iron and strychnia* is a preparation no less exceptionable. Strychnia is an agent of such potency that its purity and definiteness are of the highest consequence. Fortunately, there is no difficulty in obtaining it pure, and in demonstrating its purity. But can the same be said when it is combined with citrate of iron? Can one pharmaceutist in a hundred determine that the citrate of iron and strychnia which he purchases has the exact composition its label professes? Must he not accept it upon the good faith of the vendor? That this salt is a *chemical* compound, and that the strychnia which it should contain to the extent of one per cent. is anything else than a mixture, no one, we imagine, would venture to assert.

"Our objections to the other combinations of citrate of iron are of the same character. They are naturally indefinite in composition, do not admit of very easy analysis, and present no advantage which would not be obtained by administering the ferruginous salt with any particular adjunct the prescriber might consider desirable."

Now, with many of these remarks we perfectly agree. Some of the preparations are simply nonsensical. Still, they are now articles of commerce; some of them extensively used; and, moreover, this fact struck us as we looked about the Exhibition. They were not all alike.

We noticed some of the preparations which, soon after they were placed in the building, lost all their brilliancy of appearance, or the scales got stuck together in a mass; while others, called by the same name, were as light and bright when the Exhibition closed as when it opened. We should have fancied that a fact like this called for some notice at the hands of the Jury. Supposing these preparations contained the same amount of active ingredients, is there not, in the one case, better knowledge and greater skill in the manufacture shown which deserved recognition? We can excuse the Jury for not taking the trouble to analyse these preparations in order to ascertain whether they were what the makers asserted, although they did take that trouble in the case of quinine, where it could hardly have been necessary. Still, an experiment or two with citrate of iron and quinine, when there is such an "unscrupulous competition in price," would not have been out of place. It is the first time, too, that we ever heard an "unscrupulous competition in price" advanced as an argument for discontinuing the use of an article. We know very well that first-rate manufacturers have actually sold this same citrate of iron and quinine for less than the market price of the quinine which it professed to contain, and, we dare say, did contain. Now, this is a very unscrupulous sort of competition, and, in consequence of it, we are not surprised to find that other manufacturers have either left out some of the quinine, or put in cinchonine. But who is to blame? If people will buy things at less than their market value, they can only buy of fools or rogues, and must be one or the other themselves.

And with regard to that citrate of iron and strychnia: it is a very unnecessary and, in many respects, an objectionable compound enough; but if people will prepare it honestly we do not see why it should not be used. Of course, we must "accept it upon the good faith of the vendor." How many other medicines are we not obliged to accept on the good faith of the vendors? Do not apothecaries, who make nothing, take all on the good faith of the vendors; and druggists, too, in the case of many compound powders, extracts, and pill masses? And how many apothecaries or druggists in a hundred can test whether the compound extract of sarsaparilla they buy has any sarsaparilla at all in it, or that the compound extract of colocynth has its proper proportion of scammony, or the Dover's powder as much opium as it ought? We are obliged to exercise a great deal of faith in dealing with medicines; and if buyers and sellers would only exercise their faith, and neither their cunning nor their greed, we might get on very well.

We may pass over, for the present, the rest of the first part of Mr. Hanbury's report, waiting for that of Section A, and shall now only refer to that which relates to pharmaceutical preparations from the vegetable kingdom. In this part Mr. Hanbury notices, and praises with some reservation, the extracts of M. Berjot, and we entirely agree with his remarks:—

"In France, extracts are extensively manufactured by M. Berjot, of Caen, who exhibits a large number. These extracts, which in appearance are entirely different from those of the British pharmaceutist, are prepared *in vacuo*, the evaporation being carried to complete dryness. Thus produced, we find them in the form of dry pieces, often several inches in length, and of an oblong form, very porous and light, and generally pale in colour. Extract of liquorice, for instance, as shown by M. Berjot, is in extremely light and spongy, pale-buff, brittle, oblong cakes; in fact, in appearance it suggests pieces of *dried froth*. All the extracts are contained in wide-mouthed bottles, each provided with a hollow metallic stopper ingeniously contrived to contain *lime*, the object of which is to absorb the humidity of the air necessarily admitted each time the bottle is opened. In fact, they are mostly so hygroscopic, that, without some precaution of this nature, it would be impossible to maintain them long in their original condition; as evidence of which we may state, that three or four, of which we enclosed small specimens in pill-boxes, were found, at the expiration of a few days, to have shrunk to, perhaps, a tenth of their original volume, and to have assumed the form of ordinary soft extracts.

"Of the care with which M. Berjot's extracts are prepared we entertain no doubt; but we are far from being convinced of the expediency of carrying the desiccating process to the highest extent, and of attempting to maintain the extracts in a perfectly dry condition for daily use. We think that such extracts present, in general, a very favourable condition for transport to other countries, being, we should imagine, susceptible of no change so long as they are kept dry. But upon the shelves of the dispensary, where a large business is carried on, we can imagine that they would, from their proneness to change, be a source of perpetual annoyance. Still, as we are assured, that M. Berjot disposes commercially of his dry extracts to the extent of 4400 lbs. (2000 *kilo.*) annually, it appears evident that our objections have not all the practical force we should otherwise be ready to claim for them."

(To be continued.)

Report from the Select Committee of the House of Lords on Injury from Noxious Vapours; together with the Proceedings of the Committee, Minutes of Evidence, and Appendix. Session, 1862.

[CONCLUDING NOTICE.]

We have said that a majority of the alkali trade is in favour of an enactment compelling the condensation of muriatic acid; but, from the evidence of Mr. Hutchinson, we learn that they wish for a measure applicable to the alkali trade alone. At the same time, all the witnesses in the trade object to being compelled to use any particular system of condensation. They want the penalties of the Act to be consequent on "the escape of vapour *in serious quantity*, not upon the non-use of the best known means, but for non-compliance with the regulations of the Act. We must confess that we do not see any necessity for a special Act for the alkali trade. If we are to have simply a measure for compelling condensation without prescribing means, we do not see why all the trades in which it is proved that the noxious vapours can be condensed or destroyed, should not be included in one general enactment. A special Act for the alkali trade, and a general Act for all the other trades, as Mr. Hutchinson suggests, would be absurd. In any case in which it can be shown that the injury or nuisance may be prevented, the prevention should be insisted on. But we foresee that, however carefully the coming Act may be worded, difficulties will arise, and probably two or three sessions will pass by before it becomes law. And, whenever the Act passes, the inspectors' duties will be far from pleasant. For instance, all the manufacturers agree that perfect condensation is impossible, and that the escape of about five per cent. of the muriatic acid gas is inevitable. Now, who can say when this amount is exceeded? The perfection of the means used to condense would be a guide; but some of the makers object to inspectors having the power to enforce improvements in condensing apparatus, a restriction which, if made, would make the Act practically inoperative. On coming to the end of the evidence given by gentlemen engaged in the alkali trade, we are bound to record our high opinion of the candour, fairness, and sense of justice displayed in the testimony of these gentlemen. They admit the wrong and approve the remedy; and with them, and such as them, we may be sure that no difficulty will be found in carrying out an Act for the public good. In some of their evidence, too, great and somewhat varied knowledge was shown. It would be wrong, also, to pass over without remark the part which Lord Derby took in this investigation. He had, evidently, a well-prepared brief, and

he had thoroughly mastered it. His questions were always practical, and to the point; and he often showed his intimate acquaintance with the subject by assisting other noble lords, whose notions of the matter were rather confused. We are convinced that the manufacturers may safely leave their case in his hands, well satisfied that, with every wish to promote the interests of the class to which the noble Earl himself belongs—the landowners—he is yet able to see the impolicy of any measure which would interfere, in the smallest degree, with one of our most important branches of industry. The bill, which we may expect to be presented to Parliament next year, will probably merely compel manufacturers to make use of some apparatus of acknowledged utility for the purpose of condensation, and subject them to the visits of inspectors, at all times, to make sure that this apparatus is always in use.

With regard to nuisances, or vapours of a disagreeable nature, but which possibly are not injurious to health, and an extension of the Nuisances Removal Act, we may, for the present, defer their consideration. Various evils unquestionably call for a remedy; but the matter requires a far more extended investigation before the unlimited powers some people ask for can be entrusted to a local Board of Works, or a reconstructed Board of Health.

NOTICES OF PATENTS.

2295. *Treating Hides and Skins.* H. C. JENNINGS, Great Tower Street, London. Dated September 14, 1861.

IN the preparation of thick ox hides the hair should first be removed in the usual manner by immersion in the ordinary lime bath, the skins scraped and returned to the lime pit for twenty-four hours longer; then removed and washed in very dilute hydrochloric acid, made by mixing two parts of commercial muriatic acid with 98 of water. This treatment will have the effect of dissolving out the lime, and likewise opening the pores of the skin. The hides are then piled in dozens, with a wicker hurdle intervening between each skin, and in this condition lowered alternately into tanks filled with the following solutions: No. 1 is charged with a strong solution of alum, or sulphate of alumina, to which two per cent. each of hydrochloric and sulphuric acids have been added. Tank No. 2 is charged with a concentrated aqueous solution of soda ash, to which it is preferred to add five per cent of tungstate of soda. In these liquors the skins are to be immersed for six hours at a time, then withdrawn, closely drained, and transferred alternately from acid to alkali until the substance of the hide appears sufficiently hardened. At this stage they are to be immersed in a strong solution of the tungstate employed alone, and afterwards placed in a soap liquor, made from 15lbs. to 20lbs. of hard soap dissolved in ten gallons of rain or soft water, and agitated therein until the whole of the soap is absorbed. The goods are next washed in soft water, being left immersed for twenty-four hours to ensure the removal of the soluble salts; they are finally steeped for a like period in the ordinary tanning solution prepared from young oak bark, and, if possible, saturated with this under hydraulic pressure, so as to assist the penetration of the leather by the tanning substance.

The above directions are manifestly suited to the production of a kind of artificial leather, highly charged with a variety of mineral ingredients, and containing at the same time a certain quantity of fatty matter derived from the soap. The object of employing the tungstate of soda is not so obvious as the consideration which dictates the use of oak bark as the final step in the process.

Grants of Provisional Protection for Six Months.

2556. Ludwig Mond, Sidney Street, Brompton, Middlesex, "An improved method of obtaining hypo-nitric acid and nitric acid from nitrate of soda."—Petition recorded September 18, 1862.

2820. Richard Archibald Brooman, Fleet Street, London, "Improvements in transferring designs and prints produced by photography to stone or zinc."—A communication from François Louis Marquier, Havannah, Cuba.

2830. Joseph Byram, Moldgreen, near Huddersfield, Yorkshire, "Improvements in lamps for the combustion of paraffin, rock oil, or other oils."

2373. John Ambrose Coffey, Providence Row, Finsbury Square, and Theophilus Redwood, Montague Street, Russell Square, London, "Improvements in the manufacture of salts of ammonia and other products from the ammoniacal liquors of gasworks and animal charcoal works, and in the still or apparatus to be used in such manufacture."—Petition recorded August 27, 1862.

2835. Richard Archibald Brooman, Fleet Street, London, "Improvements in waterproofing, and in recovering products employed therein."—A communication from Adolph Baldamus, Charlottenburg, Prussia.

2837. Joseph Duke and John Clever, Puriton, Somersetshire, "Improvements in the manufacture of cement."

2856. Edward Bath, Port Tennant Copper Works, Swansea, Glamorganshire, "Improvements in treating alkali waste to obtain sulphur therefrom."

2894. Alfred Peek, Manchester, "Improvements in apparatus for evaporating saccharine and saline solutions."

2906. Thomas Sutton, St. Brelade's Bay, Jersey, "Improvements in preparing albuminised paper for photographic purposes."—Petitions recorded October 28, 1862.

Notices to Proceed.

2130. Wiliam Spence, Chancery Lane, London, "Improvements in the preparation of a red colouring matter." — A communication from Nicolas Philibert Guinon, Jean Aimé Marnas, and François Bonnet, Lyons, France.

2132. William Spence, Chancery Lane, London, "Improvements in the preparation of a blue colouring matter." — A communication from Nicolas Philibert Guinon, Jean Aimé Marnas, and François Bonnet, Lyons, France.—Petitions recorded July 28, 1862.

2756. Charles Thomas, Bristol, "Improvements in the manufacture of silicate of soda, or silicate of potash, and in the manufacture of artificial stone."—Petitions recorded October 13, 1862.

1933. Joseph Crisp and Joseph William Elliott, East King Street, South Shields, Durham, "Improvements in apparatus for burning American rock oil, paraffin oil, oil of petroleum, and other inflammable oils, spirits, or essences."

1939. William Armand Gilbee, South Street, Finsbury, London, "An improved manufacture of blue colouring matter."—A communication from Messrs. Prosper Monnet and Henry Dury, Lyons, France.

1953. Arthur Warner, Threadneedle Street, London, "Improvements in preparing materials for and in purifying coal gas."—Petition recorded July 5, 1862.

1984. Emile Jaudeau, Guildford Road, Brighton, Sussex, "An improved method of, and apparatus for, removing the bad flavour from alcohols distilled from grain, beetroot, or other vegetables, and for extracting the whole of the alcohol contained in the fermented juice."—Petition recorded July 10, 1862.

2373. John Ambrose Coffey, Providence Row, Finsbury Square, and Theophilus Redwood, Montague Street, Russell Square, London, "Improvements in the manufacture of salts of ammonia and other products from the ammoniacal liquors of gasworks and animal charcoal works, and in the still or apparatus to be used in such manufacture."—Petition recorded August 27, 1862.

CORRESPONDENCE.

Estimation of Copper.

To the Editor of the Chemical News.

Sir,—In the Chemical News of November 8 last, is given a method for estimating copper by precipitation with zinc. Can any one inform me whether arsenic (present in large quantities in many sulphuretted ores) will affect the accuracy of the results; and, if so, how it is most easily separated? Will calcination separate it sufficiently well for practical purposes, say, within 0·1 per cent. I am, &c. A Subscriber.

Swansea.

*On Mr. Hoffman's Test for the Detection of Phosphorus.**

To the Editor of the Chemical News.

Sir,—Since I wrote you last I have obtained Mr. Hoffman's reaction with phosphorus, sulphide of ammonium, and perchloride of iron. By boiling a small fragment of phosphorus with sulphide of ammonium, allowing it to cool, pouring off the sulphide into a small porcelain dish, evaporating to dryness, or until the sulphide is completely decomposed, on adding a drop or two of perchloride of iron to the residue, a violent reaction will be obtained if the solution of perchloride is neutral; but if it contains a considerable excess of acid, or is contaminated with oxide of iron to any extent, the phenomenon cannot be observed. I have every reason to believe my want of success on former occasions was owing to my having employed a solution of perchloride that contained a considerable excess of oxide of iron. I have not yet found time to investigate the subject further. Whether the reaction can be made use of in testing for the poison, as Hoffman describes, is, of course, a subject for further inquiry. At present I do not understand the nature of the reaction.—I am, &c. David Lindo.

Falmouth, Jamaica, October 23, 1862.

On the Alleged Existence of Alumina as a Normal Constituent of Wheat.

To the Editor of the Chemical News.

Sir,—My paper in your last Number of the Chemical News would, perhaps, have been more complete, in order to guard against including any silica in the residue of ignition, in paragraph No. 6, if I had stated that it is absolutely necessary to digest it in boiling dilute nitric acid, and filter off the liquor before evaporation to dryness, to obtain alumina; as I find, from numerous experiments on burnt seed corn from different localities, that silica obtains to the extent of about one grain per pound, which has possibly been mistaken for alumina by other chemists. *Vide* Mr. Reynolds' paper in the *Pharmaceutical Journal* for May, 1857.

The experiments which I have just made were conducted in the most careful manner, and show, after separation of the silica, only the faintest possible trace of alumina to exist in wheat as a normal constituent; indeed, it is so small as to be practically *nil*, and utterly incapable of appreciation by weight. This is so far satisfactory; for, had it been otherwise, it would have had rather an extenuating effect in the prosecution of any baker or miller, and would turn upon the question of normal and abnormal quantity of alumina; but there is now no pretext for it, and the finding of any appreciable quantity of alumina is a clear proof of adulteration in all cases. The published analyses of such authorities as Professor Way, Dr. Gilbert, and Mr. Lawes, also show no existence of alumina in wheat, nor give any notable quantity of silica.

The small quantity of silica stated may have proceeded from the external covering of the seed, as we know it obtains to a considerable extent in the straw, but may be wanting in the interior or farinaceous part, the sifted flour. The same may also be said of the small trace of alumina, which, it is probable, resides altogether in the envelope, associated with silica as a silicate of alumina; small, however, as is this amount of silica, it may not be without its use in protecting the farina against wet and damp.

The ascertainment of the amount of sulphuric acid is, in my opinion, wholly beside the matter and unsatisfactory, as that may obtain, to a large extent, from the sulphate of lime of the hard water used by the baker, whether alum had been introduced or not. The alumina is, therefore, the only or principal point of observation.

It must be obvious to all, from the powerful affinity of tannin for alumina as well as silica (for both are equally precipitated by it), that this process is admirably adapted for the purpose, and admits of no fallacy; no excess of tannin interfering with the result, as it is retained in the filtrate and washings.—I am, &c.

John Horsley, F.C.S.

The Laboratory, Cheltenham.

Analysis of Wheat Seed.

	Per cent.
Mineral matter extracted by acid hydrochlor.	2·00
Starch and gluten (combustible) . . .	98·00
	100·00

Non-Inflammable Fabrics.

To the Editor of the Chemical News.

Sir,—Some time since we experimented thoroughly with the ingredients named by Messrs. Rust and Co., knowing them to be the compounds of asbestos. The objections are, that the compounds would materially injure coloured goods, alter the texture of others, and could not be imparted to the fabrics in one operation. We have also tried sulphate of ammonia (NH_4O, SO_3+HO) mentioned by Mr. Blockey, on a considerable scale, not being aware of its having been patented. When being prepared for use, a large and definite quantity of water must be used; and, as it would require 1 lb. of starch to 2 lbs. of the salt, it would be useless for our purpose. Its properties are as follow:—It is entirely decomposed and driven off by heat, and even, to a certain extent, by boiling water, the ammonia being expelled, and the liquid rendered acid; therefore, the same effect would be produced when under the ironing process, &c., which acid would prove highly corrosive to all textile substances, also injuring the colour of goods. If all these difficulties could be overcome, the laundress's olfactory nerves would not endure the gas evolved by the well-known action of an alkali on a salt of ammonia. Your correspondent, Mr. Pepper, has forwarded to us samples of white and coloured muslins, prepared under his "Patent Incombustible Starch" process, for which attention we beg to thank him through your medium, and can testify to its meeting all the requirements we had in view, viz., that it renders non-inflammable both silk, linen, and cotton goods; the price also must secure its adoption by the public. We are confident that great success will crown his truly humane enterprise.

We are, &c. Maltby Brothers.

ANSWERS TO CORRESPONDENTS.

Carbonic Oxide and Nitrogen.—A long communication, in which the identity of these bodies is attempted to be proved, is declined, with thanks.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

* *Vide* Chemical News, vol. vi. pp. 163, 211.

THE CHEMICAL NEWS.

VOL. VI. No. 156.—November 29, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Observations on Cæsium and Rubidium, by OSCAR D. ALLEN, *Ph. B., Assistant in the Sheffield Laboratory of Yale College, U. S.*

THE discovery of the presence of the new elements, rubidium and cæsium, in several varieties of European lepidolite, made it a subject of interesting inquiry to ascertain whether American lepidolite would not also serve as a source for these rare metals.

A preliminary experiment, made last autumn by Mr. John M. Blake and myself, having shown that the lepidolite from Hebron, in Maine, contains these alkalies in comparative abundance, I was led to visit that locality, and there obtained the material which served for the following investigation :—

Lepidolite occurs at Hebron in large quantity, in a coarsely crystalline granite, associated with red and green tourmaline and albite. It has a granular, and at the same time foliated, crystalline structure, a pale rose to violet colour, and very closely resembles the lepidolite of Penig, in Saxony, and, like that, is also associated with the rare species, amblygonite. This locality is only eight miles from that in Paris, which has long been known to mineralogists.

Preparation of the Salts of Cæsium and Rubidium from the Hebron Lepidolite.—The process used for decomposing this mineral was based upon that employed by Professor J. Lawrence Smith for the determination of alkalies in silicates. Ten parts of the pulverised lepidolite were first mixed with forty parts of coarsely powdered quicklime; a mixture of enough water to slake the quicklime, with hydrochloric acid sufficient to form from six to seven parts of chloride of calcium, was next made ready; the two mixtures were then united, and stirred vigorously during the process of slaking, thus intimately blending the mineral with suitable proportions of dry hydrate of lime, and chloride of calcium.

It was found by experiment that practically as good results were obtained when the lepidolite was powdered sufficiently fine to pass a sieve of twenty holes to the linear inch, as when it was more finely pulverised, the fact being, that the foliated structure of the mineral exposes a large surface to the decomposing agency of the lime mixture.

The mixture was heated to redness for six to eight hours in Hessian crucibles. Care was taken to avoid a heat much above redness, as, otherwise, alkali-chlorides volatilise in dense clouds, and, the mass fusing, is absorbed to a considerable extent into the crucible, and lost. The long duration of the ignition was a matter of convenience, due to the character of the furnace employed, and probably not necessary to the decomposition of the mineral.

The agglomerated product obtained from the ignition of this mixture was detached from the crucible, and boiled with water a quarter to half-an-hour, and leached till all but a trace of the chlorides was removed. The solution thus procured, containing chloride of calcium and the chlorides of the alkali-metals, was evaporated till crystals began to form; then sulphuric acid was added as long as sulphate of lime separated, taking care to avoid an excess; and the whole mass was evaporated to dryness, and strongly heated to expel free hydrochloric acid. The residue was treated with water, and the small quantity of sulphate of lime which went into solution was precipitated by carbonate of ammonia; the filtered solution was again evaporated to dryness and ignited.

Ten and a half kilogrammes of lepidolite treated in this way afforded 2169 grammes of salts, consisting of chlorides, with a small admixture of sulphates, of sodium, lithium, potassium, rubidium, and cæsium. This quantity of salts, subjected to Bunsen's process of fractional precipitation with bichloride of platinum, furnished 132 grammes of the platinochlorides of cæsium and rubidium in which no potassium could be detected with the spectroscope. The platinochlorides were very gently heated in a current of hydrogen gas until complete reduction of the platinum took place, and the chlorides were then extracted with water.

The per-centages of cæsium and rubidium obtained from the mineral by this process were calculated from the amount of chlorine contained in these mixed chlorides.

0·5825 grammes dissolved in water, and precipitated with nitrate of silver, gave 0·5835 grammes of chloride of silver, which represents 0·1439 grammes of chlorine.

These numbers furnish the following equations :—

$$(1)\quad Rb + Cs = 0{\cdot}5825 - 0{\cdot}1439$$

$$(2)\quad \frac{Rb}{85{\cdot}36^*} + \frac{Cs}{123{\cdot}35^*} = \frac{0{\cdot}1439}{35{\cdot}5}$$

which gives Cs = 0·3002 and Rb = 0·1384. According to these proportions, the 132 grammes of platinochlorides contained 31·1969 grammes of cæsium, 14·3826 grammes of rubidium, which numbers respectively correspond to 0·3 per cent. and 0·14 per cent. of the mineral employed.

It appears, therefore, that it is practicable to extract almost one-half per cent. of the two metals from the Hebron lepidolite, even when operating on a large scale, and in a somewhat crude manner. In separating the platinochlorides of cæsium and rubidium from the platinochloride of potassium, a not inconsiderable amount of these metals went into solution with the potassium salt, thus materially diminishing the quantity obtained. Much the larger proportion of this loss was rubidium, due to the greater solubility of its platino-

* Combining proportions of cæsium and rubidium determined by Bunsen.—*Pogg. Ann.*, cxiii. 339.

chlorides. On comparing these results with Cooper's analyses† of the Rozena lepidolite, it appears that, although not quite so rich in rubidium, the Hebron mineral is remarkably rich in cæsium. The lepidolite from Rozena and Zinnwald contain, according to the published analyses, only an unweighable trace of cæsium, while that from Hebron contains more than three-tenths of one per cent.

Experiments in Separating Cæsium and Rubidium.—The process described by Bunsen for separating the new alkalies appeared to be so troublesome, requiring for the preparation of pure rubidium salts twenty to thirty extractions of the carbonates with boiling absolute alcohol (*Ann. Chem. u. Phar.*, cxxii. 353), that I have made various attempts to discover a simpler method.

In the first place, a trial was made with the picrates of the new metals. To a concentrated solution of their mixed chlorides an alcoholic solution of picric acid was added. The liquid immediately filled with fine acicular crystals. These were rinsed with water, and successively re-crystallised from fresh portions of water eleven times. Portions of the first, second, third, fourth, seventh, and eleventh crops of crystals were separately examined in the spectroscope, the picrates being converted into chlorides for this purpose, by treatment with aqua regia. No difference being observable between the spectra of the various crops, no further experiments were made in this direction. It may be here remarked that the mixed picrates crystallise with great facility in needles an inch in length, and perfectly resemble the corresponding potassium salt.

A second series of trials was made with the platinobromides of potassium, rubidium, and cæsium. The platinobromide of potassium is known to be readily soluble in water. The platinobromides of cæsium and rubidium readily separate from dilute solutions of these three metals, but carry down potassium with them. For the removal of the latter metal from the new alkalies, the platinobromides appear to have no advantage over the platinochlorides, while they are equally inadequate to the separation of cæsium and rubidium from each other. In external characters the three platinobromides closely resemble each other.

Finally, recourse was had to the bitartrates, and with satisfactory results. Carbonates of cæsium and rubidium were first prepared from the chlorides by converting them into sulphates, separating the sulphuric acid with caustic baryta, and removing the excess of baryta by carbonic acid. To the alkaline solution thus obtained, twice as much tartaric acid was added as was necessary to neutralise it. This solution was concentrated till it was nearly saturated at 100° C. The crystals which deposited on cooling, when examined by the spectroscope, showed the rubidium lines more intensely than did the original mixture, while the cæsium lines were much fainter. This product was dissolved and recrystallised from hot saturated solutions three times. The cæsium reaction in these successive crops diminished, until in the fourth it disappeared, leaving the rubidium spectrum in entire purity.

In order to ascertain whether the more soluble bitartrate of cæsium could be purified from rubidium by fractional crystallisation, the solution from which the first crystals had been removed was concentrated to nearly one-half its original volume, when, by cooling, a very small quantity of salts of the two alkalies was deposited. This operation was repeated three times, when a portion of the solution evaporated to dryness, and, examined by the spectroscope, gave only the lines belonging to cæsium. The several intermediate products containing both alkalies were then united, and another portion of each salt separated from them in the same manner. By repeating this process of fractional crystallisation four times, with about 40 grammes of the mixed salts, 23·77 grammes of bitartrate of cæsium, and 12·511 grammes of bitartrate of rubidium were obtained, while 3·74 grammes remained unseparated. It was found that the cæsium salt thus obtained, although exhibiting no impurity when tested by the spectroscope directly, *i.e*, after conversion by ignition into carbonate, was still mixed with a trace of rubidium, as, on converting it into chloride, a faint line characteristic of the latter metal was perceptible. The separation of two or three more small crops of crystals sufficed to render the residual solution perfectly free from any admixture that could be detected by a spectroscope of ordinary power.‡ The rubidium salt was also more carefully tested in the same manner, but was found to be entirely pure.

The process above described thus furnishes a simple and easy method of separating, in a perfectly pure state, a large share (in these trials about 90 per cent.) of a mixture of the two alkalies. It requires no great expenditure of time, since the solutions employed can be concentrated at high temperatures, and, on cooling, immediately deposit well-formed crystals.

Composition and Solubility of the Bitartrates of Cæsium and Rubidium.—Bitartrate of rubidium crystallises from hot solutions in colourless, transparent flattened prisms, which are often half-an-inch in length, even when formed rapidly from small quantities of solution. They remain unaltered in the air, and also are unchanged at a temperature of 100° C. The pulverised salt, dried at 100° C., was burned with chromate of lead in the usual manner.

I. 0·4681 grm. gave { 0·0902 grm. water, and / 0·354 „ carbonic acid.

To determine the base, the salt was heated to a temperature a little below redness, the resulting carbonate extracted with water from a small residue of carbon, which could not be burned away without volatilising rubidium. The carbonate was then converted into chloride, fused, and weighed without exposure to the air.

II. 1·3772 grammes gave 0·7149 grammes chloride of rubidium.

In the following statement these results are reduced to per-cents., and compared with the calculated composition of bitartrate of rubidium as expressed by the formula—

$$\left.\begin{matrix} C_8H_4O_8 \\ H\,Rb \end{matrix}\right\} O_4$$

	Calculated.		Found.	
			I.	II.
C_8	48·00	20·48	20·62	..
H_5	5·00	2·13	2·17	..
O_{11}	88·00	37·55	..	..
RbO	93·36	39·84	..	40·09
	234·36	100·00		

The solubility of this salt in hot and cold water was determined by evaporating, on the water-bath, solutions saturated at the given temperatures, and weighing the residues.

† *Jour. Prakt. Chem.*, lxxxv. 125.

‡ The instrument used was a modification of Bunsen and Kirchhoff's spectroscope, devised by Professor J. P. Cooke, and manufactured by Messrs. Alvan Clark and Sons, of Cambridgeport.

I. 11·9254 grammes of solution, saturated at the boiling-point, gave a residue of 1·2555 grammes.

One part of the salt accordingly requires 8·5 parts of boiling water for solution.

II. 17·535 grammes of solution saturated at 25° C. gave a residue of 0·205 grammes.

III. 16·094 grammes of solution saturated at 25° C. gave a residue of 0·188 grammes.

One part of the salt thus required respectively 84·53 and 84·6 parts of water at 25° C. for solution.

The bitartrate of cæsium forms crystals closely resembling the rubidium salt, but in my experiments they were usually of smaller size.

The salt obtained by concentrating the solution from which all the rubidium had been separated, was to all appearance pure. It was recrystallised, and after drying at 100° C., at which temperature it suffered no loss of weight, was analysed in the same manner as the bitartrate of rubidium.

I. 0·4718 grm. gave { 0·0786 grm. water, and 0·294 „ carbonic acid.

II. 0·5966 grm. gave { 0·101 grm. water, and 0·372 „ carbonic acid.

III. 1·3086 grm. gave 0·7708 grm. chloride of cæsium.

Assuming the combining proportion of cæsium to be 123·35, as determined by Bunsen, the following statement exhibits the composition of the salt, according to the formula—

$$\left.\begin{matrix} C_8H_4O_8 \\ H\ Cs \end{matrix}\right\} O_4$$

	Calculated.		Found.		
			I.	II.	III.
C_8	48·00	17·62	16·99	17·02	..
H_5	5·00	1·83	1·85	1·88	..
O_{11}	88·00	32·31	..	..	..
CsO	231·35	48·24	..	..	48·70
	272·35	100·00			

The discrepancy between the composition, as calculated and found, is, perhaps, due to a slight admixture of the neutral tartrate, which might possibly have been present, owing to the use of insufficient tartaric acid.

The solubility of bitartrate of cæsium was determined for the same temperature, and by the same methods as were employed in case of the rubidium salt.

I. 2·998 grammes of solution saturated at the boiling point gave a residue of 1·483 grammes.

One part of the salt requires 1·02 part of boiling water for solution.

II. 11·931 grammes of solution saturated at 25° C. gave a residue of 1·054 grammes.

III. 8·7625 grammes of saturated solution at 25° C. gave a residue of 0·7727 grammes.

One part of the salt accordingly requires 10·32 parts of water at 25° C. for solution.

The fact, that bitartrate of rubidium requires about eight times as much water for solution as bitartrate of cæsium, explains the facility with which these salts can be separated from each other by crystallisation.

In these experiments I have received the advice and assistance of Professors Johnson and Brush, for which I here take pleasure in expressing my most grateful acknowledgments.

New Haven, August 12, 1862.

Note.—Since the above was written, I have recovered from the mother-liquors and washings of the 132 grammes platinochlorides of cæsium and rubidium first obtained, an additional quantity of potash-free platinochlorides (chiefly of rubidium) amounting to 40 grammes, making the total yield 172 grammes from 10½ kilogrammes of lepidolite. Most of this remained in solution from the use of insufficient bichloride of platinum in some of the precipitations. The content of rubidium in the Hebron lepidolite thus appears to be not less than in that from Rozena.—*From the American Journal of Science and Arts*, vol. xxxiv., November, 1862.

Contributions to the History of Fluorides, by M. A. Borodin.

These researches, carried on in the laboratory of Pisa, take as a starting-point the reactions produced by the contact of even weak acids with alkaline fluorides. As pointed out by Berzelius, fluoride of potassium possesses a strongly alkaline reaction; sufficient acetic acid added to it, to take away this alkaline reaction, it furnishes, when evaporated to dryness, a salt, the concentrated solution of which is neutral, but becomes acid by the addition of an excess of water. By distillation, the dry salt yields acetic acid, and fluoride of potassium remains (Berzelius).

Considering the remarkable tendency of monatomic fluorides to form double compounds, and accepting the theoretical views developed by M. S. Cannizzaro,* it is asked by M. Borodin, if it be possible to assimilate a monatomic or double fluoride with one chemical molecule, like those of double sulphates; or rather, whether certain fluorides should be compared to compounds containing water or alcohol of crystallisation to acid salts, formed by monobasic acids, such as biacetate, bibenzoate, quadristearate of potash, &c.?

According to the first hypothesis, hydrofluoric acid would be bibasic, like sulphuric, succinic acids, &c., and its formula would be doubled, the fluorine becoming a diatomic radical = 2 × 19, like oxygen or sulphur. But to justify this hypothesis, the vapour density of fluorides must be double that observed, and the fluorides be isomorphous with sulphides and not with chlorides. Thus, fluorine would present an exception to the general laws of modern chemistry.

According to the second hypothesis, there would exist no disagreement between the physical and chemical properties of fluorine compounds. Double monatomic or acid fluorides would not be distillable, or, if volatile, their gaseous volume would be double that of simple fluorides, the vapour products constituting a simple mixture of simple fluorides, which, before their dissociation, constituted the non-vaporised molecules.

To clear up these points, the author proposed—

1. To ascertain to what extent fluorides are capable of forming double compounds.

2. To study volatile monatomic fluorides with organic elements.

To investigate, in the first instance, the action of acetic acid on alkaline fluorides, the author prepared a fluoride of potassium by calcining pure crystallised hydrofluorate of fluoride of potassium in a platinum vessel.

Mixed with dilute acetic acid, a solution of this fluoride of potassium gave, on evaporation, a crystallised salt, which, when calcined, disengaged hydrofluoric acid, leaving fluoride of potassium. Burnt in a tube with oxide of copper, it yielded water, with no trace of carbonic acid.

Experiment.		Theory.	
KFl.	74·52	KFl.	74·35
HFl.	1·43	HFl.	1·28

* See *Repertoire de Chimie Pure*, vol. i. p. 201.

The author's experiments go to prove that the reaction of acetic acid on fluoride of potassium is represented by the following equation:—

$$C_2H_4O_2 + 2KFl.HFl. = KFl.HFl. + C_2H_3KO_2.$$

With acetic acid and fluoride of sodium the action is the same.

An aqueous solution of benzoic acid does not react on fluoride of potassium; an alcoholic solution of benzoic acid mixed with an aqueous solution of fluoride is precipitated; the crystalline precipitate is scarcely soluble in alcohol; and experiments show that it consists of a mixture of bibenzoate of potash and acid fluoride,

$$C_7H_5KO_2.C_7H_6O_2 + KFl.HFl.$$

Valeric, citric, oxalic, and tartaric acids also give with fluoride of potassium a mixture of salts, by virtue of a reaction similar to the above. This is the result of the analysis of the residuum of calcination, consisting of a mixture of carbonate of potash and fluoride, KFl. A binoxalate precipitate is immediately obtained by an alcoholic solution of oxalic acid.

Hence it follows that all these organic acids decompose fluoride of potassium, giving acid fluoride, without combining, like hydrofluoric acid, with the fluoride KFl.

Anhydrous citraconic acid exerts no action on the fluorides of potassium or sodium. It is, doubtless, the same with the other anhydrous organic acids.

The monatomic organic fluorides studied by the author are—1. An acid fluoride, fluoride of benzoyle, first obtained by the author. 2. Fluoride of methyl.

Did these bodies possess the faculty of uniting with monatomic fluorides in the same way as metallic fluorides, they would form other bodies having the elementary composition of benzoic and metallic compounds—O + 2Fl.; that is to say, we should have—

$$C_7H_5OFl.HFl. = C_7H_6O_2 - O + 2Fl.$$
$$C_7H_5OFl.KFl. = C_7H_5KO_2 - O + 2Fl.$$
$$C_7H_5OFl.CH_3Fl. = C_7H_5(CH_3)O_2 - O + 2Fl.$$

The best way to prepare fluoride of benzoyle is to introduce into a platinum retort a mixture formed of 1 equivalent of chloride of benzoyle and rather more than 1 equivalent of KFl.HFl., finely powdered and perfectly dry. Hydrofluoric acid vapours are disengaged, and when these vapours cease to be given off the reaction is at an end. The portion which passes over at 155° and 162° is distilled, collected, and condensed in a small platinum receiver.

To protect its glass, the thermometer is placed in a small platinum tube traversing the tubulure holding the retort, the operator having previously ascertained that the platinum tube had no noticeable effect on the temperature of the vapour. To obtain perfectly pure fluoride of benzoyle, the distilled products are redistilled in small portions.

The reaction is represented by the equation—

$$C_7H_5OCl. + KFl.HFl. = C_7H_5OFl. + KCl. + HFl.$$

When the pieces of the apparatus are well jointed, almost the theoretical quantity is obtained. Analysis gave—

	Experiment.	Calculation ($C_7H_6O.Fl.$)
Carbon. .	67·77	66·85	67·74
Hydrogen .		4·31	4·03

Fluoride of benzoyle is an oleaginous, colourless liquid, denser than water, with an odour more irritating than the chloride. It boils at 161°·5 (corrected), at a pressure of Om 745. The pure liquid scarcely attacks glass; nevertheless, the density of its vapour cannot be determined in a glass vessel.

Its reactions are analogous to those of chloride of benzoyle. It dissolves, but does not decompose in ether. Water changes it into hydrofluoric and benzoic acid. It gives benzoate and fluoride with potash; with alcohol it gives benzoic ether; with ammonia, benzamide.

The author has not succeeded in combining, either directly or indirectly, fluoride of benzoyle with fluorides.

Having failed with fluoride of benzoyle, the author has not tried fluoride of methyl.

Although it has not been proved impossible to effect this kind of combination, its existence appears very doubtful.

The author believes he has established—

1. That the tendency of monatomic fluorides to form double fluorides is limited to the formation of mineral acid fluorides and double salts.

2. Monatomic fluorides combine only with hydrofluoric acid.

3. Fluorides of potassium and sodium have so strong a tendency to change to acid fluorides, that they yield with the greatest ease half their metal to even the feeblest acids.

4. Organic fluorides are more allied to the corresponding chlorides than are mineral fluorides to the corresponding chlorides.

5. No comparison can be made between the formulas of simple and double fluorides, since the former correspond to a gaseous molecule of two volumes, the latter to a solid or liquid particle, comparable to those bodies containing water or alcohol of crystallisation, &c.

6. Hydrofluoric acid possesses the same peculiarity as water. Both combine more readily with fixed, saline, mineral compounds, and so form a solid or liquid molecule, than with volatile organic compounds. All compounds containing water of crystallisation or hydrofluoric acid are decomposed by heat.—*Nuovo Cemento*, vol. xv. p. 305.

On the Composition of Sulphate of Cadmium, by M. C. Rammelsberg.

Some years ago, in the *Sitzungsberichte der K. Akad. der Wissenschaften zu Wien*, vol. xv. p. 23, M. de Hauer stated, that sulphate of cadmium contains 8 molecules of water to 3 molecules of sulphate, $3(CdO.SO_3) + 8Aq.$ This composition, complicated as it appears, is confirmed by M. Marignac's analysis of sulphate of didymium, and that of sulphate of yttria by M. Rammelsberg. The three salts have the same crystalline form; they crystallise in oblique prisms, with rhomboïd bases, and their angles are very near.

The form of sulphate of cadmium has been determined by M. Kopp* and by our author, and that of sulphate of didymium by M. Marignac. As to sulphate of yttria, M. Rammelsberg finds on it the same surfaces as sulphate of didymium.—*Poggendorff's Annalen der Physik und Chemie*, vol. cxv. p. 579, 1862, No. 4.

TECHNICAL CHEMISTRY.

Webster's Process for Making Oxygen Gas.

The following report has been made, by Dugald Campbell, Esq., F.C.S., to Messrs. John H. Porter and Co., the proprietors of the patent:—

As requested by you, I have made experiments in order to examine into, and report upon, the process of

* Rammelsberg, *Handbuch der Krystallographichen Chemie*, p. 103.

Mr. James Webster, of Birmingham, for "manufacturing oxygen gas, and obtaining certain other products," described in the specification of his patent, No. 2607, dated October 19, 1861.

The materials which I employed in my experiments were commercial nitrate of soda of the ordinary quality, and a common oxide of zinc; the first of value, I should say, at from 13*l.* to 14*l.* per ton, and the latter at from 30s. to 40s. per ton.

The mode of operating was as follows:—10 lbs. of the nitrate of soda, and 20 lbs. of the oxide of zinc, both previously dried, were mixed roughly together, and thrown into a red-hot retort. In a minute or two, when the oxygen gas began to come off, which was ascertained by the gas having the power of supporting combustion, the gas was made to pass into what was named the purifier, which I shall afterwards describe, and from thence into a graduated gasometer.

When the gas had ceased to come off, the gasometer was shut off from the rest of the apparatus, and the contents of the retort, emptied into a tray, and mixed roughly with an additional 10 lbs. of dry nitrate of soda, were returned into the retort, and distilled as before, and when no more gas was evolved the gasometer was again shut off, and the contents of the retort discharged into a tray, and again mixed in a similar manner with 10 lbs. of the dry nitrate, and distilled as before.

The material in the retort has now become, to some degree, pasty, and is considered no longer fit to have more nitrate of soda added to it, and, from the original weight of 50 lbs., it is now reduced to 37 lbs., or has lost 13 lbs. It consists as follows:—

In 100 parts.

Sand with oxide of iron	13·66
Oxide of zinc	30·20
Anhydrous soda	24·80
Nitrite of soda with a little nitrate	31·34

It will be seen from the above, that this material contains 24·8 per cent. of anhydrous soda, which is equal to 32 per cent. of hydrate of soda, and, by boiling it in water, this hydrate of soda, together with the nitrate of soda, are dissolved out from the oxide of zinc, and may be readily separated from each other by crystallising out the nitrate, leaving the hydrate.

But it sometimes happens, that from too great a heat being employed in obtaining the gas, or from the nature of the iron of the retort used, that, besides these salts of soda, a salt of iron and soda is formed, namely, the ferrate of soda. This salt is green, and is not separated by crystallisation from the hydrate, and consequently would much contaminate it, and render it much less valuable. In my opinion it is quite easy to avoid such an action taking place.

But in the event of such an action having taken place, the use to which the residual material may be afterwards put to in the process, namely, in the purifying of the gas as it passes through the purifier, alters it, and converts it into a substance more readily to be dealt with.

The purifier, spoken of before, consists of a deep jar, at the bottom of which 5½ lbs. of water are placed; the gas from the retort is made to enter just above the water, and passes up through perforated trays, on which are spread the 37 lbs. of residual material from the retort, broken into a rough powder, and moistened with 6 lbs. of water, making together 43 lbs.

In all my experiments the residual material remained in the purifier during the distillation of the 50 lbs. of the material only, when it was removed and weighed.

The water at the bottom of the receiver is now strongly acid, with a mixture of nitrous and nitric acids, and has increased in weight in my experiments from 2 lbs. to 3½ lbs., depending upon the degree of heat used in the process. That being the case, its specific gravity is variable, and, in the course of one distillation of 50 lbs., the acid water is not of much value; but it might remain in the purifier during several charges, when it would become strong and of real value, or it might be drawn off, and added to the dry residual material removed from the trays after it has done purifying the gas.

This residual material upon the perforated trays in the purifier, after the passing of the gas from 50 lbs. weight of the materials, has increased in weight in my experiments from 2 lbs. to 3 lbs., according to the temperature at which the materials are distilled, and also according to the nature of the residual material employed in the purifier, and it is now much changed, and the hydrate of soda is now almost totally converted into nitrate of soda, and any ferrate of soda is decomposed. Its composition is as follows:—

In 100 parts.

Water and sand	26·27
Carbonate of soda	5.00
Oxide of iron	6·00
Oxide of zinc	22·82
Nitrate of soda with a very little nitrite	39·91

The way which I would suggest of dealing with the above substance, is to add the acid water from the bottom of the purifier to it, so as to neutralise any carbonate of soda which it may contain, and boil it with water, which will dissolve the nitrate of soda from the insoluble oxide of zinc, and the solution of nitrate is afterwards evaporated for the nitrate.

The yield of gas from 20 lbs. of oxide of zinc and 30 lbs. of nitrate of soda in my experiments was very close, varying only from 157·85 to 159·03 cubic feet, and the time occupied in each working of 50 lbs. was, as near as may be, 9½ hours.

I was unable to fix exactly what the consumption of fuel was for one charge, but, from the data I obtained, I should say it was under 9d.

On analysing the gas, I was surprised to find that it contained a considerable per-centage of nitrogen, in my experiments varying from 26·50 to 32·80 per cent.; for, independently of its supporting combustion very well, and increasing the illuminating power of coal-gas to a great degree, I should not have expected nitrogen to be eliminated from the materials used, by the heat which was employed. However, finding the nitrogen there, it appears to me that it must have got there by using too high temperatures,* and I think, by experimenting at different temperatures, you may find out one, where little, if any, will be produced, or one, at any rate, at which much less will be produced.

On the Theory of the Manufacture of Soda, by WILLIAM GOSSAGE.

THE last Number of the CHEMICAL NEWS contains an elaborate paper on the "Theory of the Preparation of Soda by Le Blanc's Process," by M. A. Scheurer-Kestner, from which, I observe, that several eminent chemists

* Acting upon these suggestions, the proprietors have obtained a higher degree of purity in the gas, which they find to be improved also by the addition of more water to the materials in the purifier.

are now approximating to the theory on this subject which I propounded upwards of twenty years since.

At the meeting of the British Association, which was held in Manchester in 1861, I read a paper before the chemical section of that body, entitled "A History of the Soda Manufacture," which contained the following observations on this subject, and I shall be much obliged if they can be allowed to have the additional publicity which will be given them by appearing in the CHEMICAL NEWS:—

"In giving directions for the decomposition of sulphate of soda, Le Blanc recommends the following proportions of materials to be used:—

1000 parts of sulphate of soda.
1000 „ of chalk.
550 „ of carbon.

These proportions are in the ratio of about three equivalents of chalk for two equivalents of sulphate of soda. They are the same which are now generally employed by the soda manufacturers of the present day, except that about 750 parts of small bituminous coal are substituted for the 550 parts of carbon.

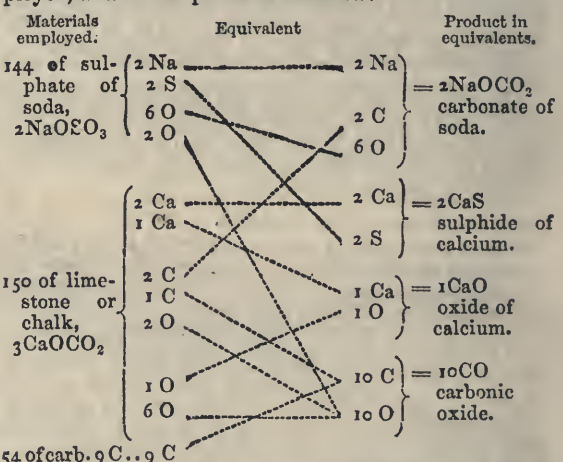
"The mixture is fluxed in reverberatory furnaces, producing black ash, containing carbonate of soda, sulphide of calcium, and oxide of calcium. According to the skilfulness of the workman in conducting this operation, there remains in the black ash or rough soda obtained, less or more of undecomposed sulphate of soda, and there is produced less or more of soluble sulphide of calcium.

"The true composition of black ash or rough soda, also the rationale of its formation, are not settled questions. It has been held by Dumas and other eminent French chemists, when explaining the reactions which occur in Le Blanc's masterly process, that a peculiar compound, insoluble in water, consisting of sulphide and oxide of calcium (called by them oxy-sulphide of calcium), is formed during the decomposition of sulphate of soda by carbon in the presence of lime; also, that it is essential that sulphide of calcium should be thus combined with oxide of calcium to destroy the supposed solubility of the former in water, and thus prevent the formation of sulphide of sodium at the expense of carbonate of soda; and they assumed that, in consequence of the necessity to form this supposed compound, it was needful to employ more than one equivalent of lime for each equivalent of sulphate of soda used for the production of rough soda.

"According to this theory, it is essential that the supposed insoluble compound should continue to exist, in its integrity, so long as it is exposed to the reaction of water or of solution of carbonate of soda. Now, I pointed out in the year 1838, in the specification of a patent obtained by me for improvements connected with the soda manufacture, that the undissolved residuum remaining from the lixiviation of black ash with water consisted almost entirely of monosulphide of calcium and carbonate of lime; in fact, when the lixiviation is effected with a large proportion of water, so as to produce a weak solution, the oxide of calcium may be converted entirely into carbonate of lime, which is then found mixed with the mono-sulphide of calcium; and yet this conversion of oxide of calcium into carbonate of lime, and consequent disintegration of the supposed insoluble compound, is effected, and the supposed soluble sulphide of calcium is set at liberty, in the presence of solution of carbonate of soda; and this takes place without occasioning the production of sulphide of sodium in solution. The fact is, that mono-sulphide of calcium is perfectly insoluble in water; and it is only to the extent to which poly-sulphide of calcium is formed, that solution takes place, and consequent production of sulphido of sodium. The real advantage obtained by the use of an extra proportion of lime arises from this affording a larger amount of surface for reaction, and thus expediting the decomposing operation, and thereby decreasing the formation of poly-sulphide of calcium.

"In connection with this view of the subject, I pointed out that, when well-made black ash is digested in alcohol, there is no caustic soda dissolved, although the same black ash yields caustic soda abundantly by lixiviation with water. From this, I inferred that caustic soda did not exist in the black ash ready formed, and that it was produced, during lixiviation with water, by the reaction of caustic lime on carbonate of soda, which could not have been effected without the disintegration of the supposed insoluble compound.

"Assuming these views to be correct, and omitting the minor products of the black ash operation; also assuming the decomposition of the sulphate of soda and formation of carbonate to be perfect, we may form this diagram as exhibiting the reaction of the materials employed, and of the products obtained:—



In this formula I have assumed pure carbon to have been used, also that the gas evolved is entirely carbonic oxide, whilst, in fact, a large proportion of carbonic acid is produced. Small coal is also used, in practice, instead of pure carbon; and it is desirable that the finished black ash should contain a considerable proportion of unconsumed pieces of coke; therefore, a proportion of small coal is used in the mixture, about double the quantity indicated for carbon."

From this it will be observed that I have long entertained the view, that mono-sulphide of calcium is a compound insoluble in water, and that this is contained in black ash or rough soda in the state of simple mixture with carbonate of soda and caustic lime.

I have repeatedly proved the correctness of my view, as to the insolubility of mono-sulphide of calcium, by preparing this compound by the decomposition of gypsum by means of carbon. If this is effected without contact of air, an insoluble sulphide of calcium is obtained; but, if air has access during the decomposition, some soluble poly-sulphide of calcium is produced; but, even in this latter case, the greatest proportion of the product is an insoluble compound, as may be proved by treating it, out of contact with air, with water to abstract the soluble

portion, then adding solution of carbonate of soda to the residuum, which will yield no sulphide of sodium in solution.

The insoluble residuum, when treated with hydrochloric acid, yields abundant evidence of its containing metallic sulphide.

From this it is obvious that we have no occasion to resort to M. Dumas' hypothesis for an explanation of the reactions on which Le Blanc's process is founded.

Widnes, near Warrington.

On the Manufacture of Copal Oil Varnish, by M. H. VIOLETTE.*

THERE are three principal varieties of copal used in commerce—the hard, the semi-hard, and the soft. The two first are employed only in making oil-varnish; the latter, with less resisting power, is used for interior applications.

Hard copal is procured from Calcutta or Bombay, that from Calcutta being the best. Semi-hard copal comes from Africa. It is highly necessary that commercial lots should be composed of identical resins; they are made up of various qualities, which the buyer should be able to distinguish. (See "Histoire Naturelle des Drogues Simples," by M. le Professeur Guibourt.)

By heating, with steam, a vessel containing hard copal, some fragments soften more or less, while others remain intact. On throwing various fragments of hard copal into a bath of melted tin, at about 300°, some of the fragments melt and spread, while others resist, and are fused only at a much higher temperature.

The solvents of hard and semi-hard copals are not known at present; that they exist is certain, because the resins flow naturally from the tree which produces them, in the form of a limpid liquid, which thickens and hardens by exposure to the air, losing by evaporation the solvent essential oil.

Notwithstanding the numerous trials of chemists and practical men, there is no other way of dissolving these copals in the mixture of essence of turpentine and oil, the vehicle used in making varnish, than by previously decomposing them by heat. The extent of this alteration, effected by heat, is of great importance, for the higher the temperature employed, the deeper is the colour of the varnish, which, in the operation, loses its primitive limpidity.

The author has determined by experiment the following fusing and distilling temperatures of copals:—

	Fusion.	Distillation.
Hard copal . . .	340°	360°
Semihard copal . .	180°	230°

The above copals, when melted only, dissolved neither by heat nor cold, in essence of turpentine, their solubility corresponds, or is relative, to a certain degree of decomposition, which the author set himself to determine practically.

Our author's experiments lead him to the conclusion, that hard and semi-hard copals become soluble in a mixture of essence and oil, only after losing 20 to 25 per cent. of their weight. Beyond a loss of 25 per cent. they become more and more soluble, but at the same time darker, and yield less varnish, owing to the increased loss. He shows, also, that the least degree of coloration corresponds to the lowest temperature necessary—that is to say, about 360°: he asserts, in consequence, that, to obtain the largest quantity of the best varnish, the copals must lose 25 per cent. of their weight, by distillation at 360°.

M. Violette adds, however, that copal which has lost 10 per cent of its weight, or even less, will readily dissolve in essence of turpentine, thickened by prolonged exposure to air and light; the actual cause of this singular modification of the essence is unknown. Were it possible, by a short, easy, and cheap process, to reproduce this state, it would effect a great improvement in the manufacture of varnish.

In its actual condition, copal which has lost 10 per cent. of its weight by distillation does not dissolve in ordinary commercial essence, whether deprived of its water by mixing it with absorbing agents, or several times distilled.

Copal oil, says the author, is a product worthy of attention, as it represents about one-fourth the weight of the copal. It is limpid and yellowish. Its density about 0·80; it burns in the air, giving a bright light; it is soluble in oil and essence of turpentine; it dissolves soft and semi-hard copals;† it might then be usefully employed in making varnish, especially if it could be deprived of its strong and persistent odour; its employment would compensate completely for the loss of copal by distillation, and the manufacturer would thus avoid loss of material.

M. Violette closes his memoir by expressing the wish that intelligent manufacturers should try to produce soluble copal, and enrich industry with this new product.

* This important investigation is extracted from the "Memoirs" of the Imperial Society of Science, Agriculture, and Art of Lille. The author condenses in these words the history of the manufacture of varnish:—"The manufacture of varnish is as yet only a manual art, and certainly no science. The art of making copal-oil varnish, described by the monk Theophilus, in the twelfth century, has since then made no sensible progress. The processes were long unknown to any but the makers; hence the number of worthless and often impracticable receipts which encumber books on the subject. The first descriptions were given by Watin, in his 'L'Art du Peintre, Doreur et Vernisseur,' published in 1772; then came Tingry's treatise; and, lastly, the remarkable treatise, 'L'Art de Faire les Vernis,' by Tripier-Deveaux, published in 1845." M. Violette's work is to be continued.

† A long time ago, we distilled hard copal, and well remember that the viscous liquid obtained by rapid distillation dissolved hard copal. —Bw.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

November 20, 1862.

Professor A. W. HOFMANN, *LL.D., F.R.S., President, in the Chair.*

THE Minutes of the previous meeting having been read and confirmed, the Society proceeded to ballot for the election of Mr. William G. Blagden, who was declared unanimously elected a Fellow of the Society.

The special business of the evening commenced with the reading of a paper, by G. B. BUCKTON, Esq., F.R.S., on "*Some Reactions of the Organo-Metallic Radicals.*" After adverting to the different methods known for procuring the organo-metallic radicals, the author particularly noticed the action of sodium upon zinc ethyl, whereby sodium ethyl is formed by displacement of zinc. The question then discussed was—How far, and in what order, can substitutions be effected in the various organo-metalloids, by acting upon them with simple metals or their haloid salts? Experiment proved that sodium expels part of the mercury from mercuric ethyl, the action being somewhat similar to that observed in making sodium ethyl. The double compound,

$$\left(2\left\{\begin{matrix}HgE_2\\HgE_2\end{matrix}\right\}+2NaE\right)$$

however, breaks up violently, by a gentle heat, into ethy-

lene and hydride of ethyl. Contrary to expectation, boiling triethyl stibene, SbE_3, is not affected by sodium, although, from the electro-negative character of antimony, it was thought probable that ethyl would have been extruded, with formation of an alloy, $SbNa_3$. After noticing the difficulties which present themselves in satisfactorily separating cadmium ethyl from chloride of zinc, produced by reacting on zinc ethyl with chloride of cadmium, the behaviour of mercuric ethyl towards tin salts was discussed and exemplified by the equation—

$$3HgE_2 + 2SnCl_2 = 3(HgECl) + Sn_2E_3Cl,$$

in which three-fourths of the chlorine of the tin salt is replaced by ethyl, the mercury radical being reduced to its chloride. The salts of antimony act somewhat differently upon mercuric methyl and mercuric ethyl. In the former case, a double salt is formed with the formula—

$$3[HgMeCl] + SbMe_3Cl_2;$$

whilst in the latter, the final product is mercuric ethyl and tri-ethylstibene, the change being then represented by the equation—

$$3HgE_2 + SbCl_3 = 3(HgECl) + SbE_3.$$

The action of the tin radicals upon metals and their salts was then treated of, the fact, that sodium does not decompose the boiling tin radical, being mentioned. As mercuric ethyl with stannic bichloride gives rise to the formation of a salt of the tin organo-metallic radicals just now described, an analogous result was anticipated from the action of bichloride of titanium upon stannic diethyl, and that probably titano-sesquiethyl chloride (Ti_2E_3Cl) would be one of the products of the reaction. The substances act, however, only when gently heated, and the liberation of gas shows that the titanic ethyl is at once broken up. The following equation expresses the actual change:—

$$2SnE_2 + 4TiCl_2 = 2Ti_2Cl_3 + Sn_2E_3Cl + ECl.$$

The paper concluded with considerations upon the probability of forming titanic diethyl by taking advantage of reactions similar to those successfully employed in the formation of boric ethide and boric methide.

When describing the titanic reactions, Mr. Buckton took occasion to remark, incidentally, that having procured, by the kindness of Mr. Riley, a large supply of rutile, he had been enabled to prepare the bichloride of titanium by incorporating the finely-powdered mineral with lamp-black and a little gum, drying the mixture, and heating to redness in a porcelain tube, through which a current of chlorine gas was passed.

The President addressed an inquiry both to Mr. Buckton and to Dr. Frankland, whom he knew to be well acquainted with the subject under discussion, with reference to the possibility of introducing *two* metals into the same organo-metallic radical; thus, was it possible, without alteration of the vapour volume, to construct a body of the formula—

$$\left.\begin{matrix} R \\ R \end{matrix}\right\} \begin{matrix} X \\ X \\ X \\ X \end{matrix}$$

in which the letters "R" should represent two different metals, and "X" a common radical? And, further, had Dr. Frankland been successful in forming a double or conjugate radicle, such as might be represented by the formula—

$$(ZnE + ZnMe).$$

Dr. Frankland, in reply, stated that he had hoped to have been able to prepare the body last named by acting upon the iodide of zinc ethyl with zinc methyl, but his efforts had hitherto failed. As examples of departure from analogy, he would instance the boric ethide, BoE_3, which was known, but not yet the corresponding compound of silicon; so also ethyl and methyl behaved in a perfectly different manner with respect to boron. He found, indeed, that the reactions governing this newer direction of chemical investigation were seldom so certain and definite as those we are accustomed to depend upon in the purely inorganic branch of the science.

Dr. Odling asked a question regarding the power of replacing an atom of oxygen in these compounds in much the same way, for instance, that hydrogen could be replaced in ammonium; or, in the formula first referred to by the President, could *one* or *three* equivalents of "X" be substituted without alteration of the type?

Dr. Frankland did not consider there was any evidence at present which allowed this to be practicable.

Mr. Porrett having been invited to take the Chair, the President begged leave to call the attention of the Society to an experiment he had prepared, which, although not entirely novel in its character, possessed many features of interest to chemists, who, like himself, were in search of well-devised methods of illustrating experimentally some of the newer facts in chemical science. It was observed some time ago by MM. Buff and Wöhler, in the course of some experiments upon electrolytic decomposition, when a plate of aluminium was employed as the negative terminal in the ordinary arrangement for the decomposition of water, that, as soon as the current was established, instead of pure hydrogen being evolved, a spontaneously inflammable gas made its appearance, which, on further investigation, proved to be composed of hydrogen and silicium, this latter element having obviously been derived from the sheet of metal in which silicium occurred as an impurity. Other methods had since that time been elaborated, and several processes were known for the preparation of silicated hydrogen. He was, however, struck by the remarkable facility afforded by the silicide of magnesium as a source from which to prepare the gaseous compound in question. Dr. Martius had been engaged in making metallic magnesium, by reduction of the anhydrous chloride with sodium, and, in order to carry out the operation on a larger scale, had employed a Hessian clay crucible; the product differed, however, from the pure metal by containing silicium, and giving off inflammable gas during solution in hydrochloric acid. He had thus been induced to try the effect of introducing a larger proportion of silica, and had obtained a fused mass, which exhibited this reaction in a striking manner, and readily furnished large volumes of silicated hydrogen.

Dr. Hofmann recommended for this purpose to take 80 parts of fused chloride of magnesium, 70 parts of silicofluoride of potassium, 40 parts of sodium cut into small pieces, and 20 parts of the chloride of potassium and sodium, mixed in equivalent proportions. These ingredients were to be shaken together in a dry bottle, transferred to a clay crucible, and quickly heated to redness; the product contained often some globules larger in size, and more definite in character, which had already furnished results by analysis approximating to the formula Mg_2Si (equivalent of Si = 28). The powdered mass, when triturated with hydrochloric acid, gave off abundance of gas, and kept up a lively combustion within the mortar. Dr. Hofmann had already prepared a jar of this gas, which he passed through a delivery tube, and allowed to escape slowly in bubbles. As they rose to the surface of the liquid in the trough (hydrochloric acid diluted with boiled water), each bubble inflamed spontaneously, burning in the air with a brilliant white flame, like phosphoretted hydrogen, and producing the same kind of rings; a more rapid combustion furnished visible flakes of silica, which floated in the atmosphere of the room, somewhat like the fumes of burning zinc. The gas was slowly decomposed on standing over water, forming a white deposit of silica; but with regard to its exact composition Dr. Hofmann hesitated to assert more at present than the mere opinion, that it would be found on analysis to be the marsh gas of the silicon series, and be similarly represented thus:—

CH_4—Marsh gas.
SiH_4—Silicated hydrogen.

The gas which had hitherto been prepared always contained a certain quantity of free hydrogen in admixture, which it was not possible to separate. A powerful frigorific agent would, perhaps, condense the silicium compound alone, but he would suggest a trial of bromine or chlorine as a likely means of arriving at the proportion of hydrogen in combination; the free hydrogen would remain unaffected, and its volume could be subtracted from the original bulk of gas operated upon. *Apropos* of this remark, he was desirous of mentioning a very instructive lecture-experiment, which consisted in bringing a few drops of bromine into contact with sulphuretted hydrogen gas, when, at the same time that a deposit of sulphur was formed, the volume of the gas became doubled.

A paper was then read by Edward Nicholson, Esq., Staff Assistant-Surgeon, on the "*Specific Gravity of Urine as a Measure of its Solid Constituents.*" The author commenced by referring to the inaccuracy of the methods commonly adopted in the analysis of urine, and to the want of care evidenced in the construction of urinometers. The per-centage amount of urea was generally stated—on the authority of Dr. Golding Bird, and others—to bear a fixed relation to the saline or mineral constituents of the urine, and to be expressed by a number resulting from the multiplication by 2·33 of the excess of apecific gravity over 1000. That this rule was erroneous, was proved by the direct determination of the amounts of urea by Liebig's process in several samples of healthy and diseased urine, and estimating, at the same time, the chlorides and other salts for comparison; when great variations were observed not only as regards the urea, but in the relative proportions of phosphates, sulphates, &c. The lowest gravity noticed was in the case of a patient suffering from ague, when the urine weighed only 1001·14.

In answer to an inquiry on the part of the President, Dr. Nicholson stated that he had employed Davy's method for the determination of urea, but that Liebig's gave more reliable results: in the latter process, it was, however, necessary first to separate the chlorides, particularly when experimenting with specimens of urine of unusually low specific gravity.

The President then declared the meeting adjourned until Thursday, December 4, when the following papers will be read:—On the "Specific Gravity of Urine," by Dr. Woods; and on the "Reactions of Sulphate and Sulphide of Lead with Hydrogen and Carbonic Oxide," by Mr. Rodwell.

NOTICES OF BOOKS.

International Exhibition: Jurors' Reports: Class II. *Section* B. *Medical and Pharmaceutical Products and Processes.*

The notice of the vegeto-alkaloids brings out the following somewhat innocent remarks on impure quinines:—

"The purity of a drug so important and high-priced as quinine ought to engage the attention of each pharmaceutist, who should rigorously refuse all which may not stand the required tests, nor should the medical man and the directors of hospitals exercise a less vigilant care. The use of quinine imperfectly purified is open to objection, for which the reduction in price by no means compensates. The admission of so valuable a medicine in a form acknowledged to be impure, and that without any standard by which to determine the amount and nature of impurity which are to be held allowable, affords opportunity for sophistication only limited by the principle of prudence of the manufacturers. In such a compound, the question most naturally arise: How much of this effect is due to the quinine, how much to the quinidine, and how much to the other constituents of this preparation? We think it would be altogether more scientific to discard such a substance, and to employ the cinchona alkaloids in those forms of purity in which they are now so easily obtainable."

We, too, are inclined to think that it would be more scientific to discard the use of a substance, the composition of which is altogether unknown to the prescribers. What hospital, or unbleached, quinines may usually be, we do not know, but we have seen a specimen which contained 30 per cent. of sulphate of cinchonia, and which sold for a higher price than would have been given at the time for the quinine present. The use of such preparations calls for a much stronger condemnation than is contained in the paragraph we have quoted above. It is not merely unscientific but dishonest. If medical men will give a fair trial of the sulphates of cinchonia and quinidine, by all means let them do so, and make us acquainted with the value of these salts. But let us have none of this cheap quinine, which is quinine, quinidine, and cinchonine in accidental proportions, or in proportions arranged to secure the largest profit to the seller. Why should we not have hospital strychnia, hospital morphia, and a lot of other things prepared for those who can see but one merit in a medicine—cheapness. The display of cinchona alkaloids and products in the Exhibition was large and important, and only fair justice is done in this report to the collections of the Messrs. Howard, and Dr. Zimmer, of Frankfort. The latter, indeed, deserved a much longer notice than it has received.

The chemical products of opium in the Exhibition—striking displays to the initiated—are quickly disposed of, due notice, however, being taken of the productions of Messrs. McFarlane, Morson, Smith, and, in the foreign departments, the displays by MM. Menier and Merck. The report affords us no information on the *thebo-lactic* acid of the Messrs. Smith, which the Jury ought certainly to have obtained. An account of this body would have had some interest for many readers of the report, who could easily have found, if they did not already know, all about igasurine for themselves. But this latter is not the only unnecessary information with which the reader is furnished. Here is another specimen. "*Aconitine*, both amorphous and crystallised, is shown by Messrs. Morson and Son. The aconitine of these manufacturers is well known for its superiority in virulence, a fact which enables it to command a very high price. Messrs. Hopkin and Williams are also English manufacturers and exhibitors of this alkaloid."

The aconitine of the Messrs. Morson is certainly a well-known article, and its superiority in virulence to the Continental aconitine, which was in use when Mr. Morson commenced the manufacture, and to much that is imported now, is unquestionable. It is pure; and as it is a troublesome and expensive article to make, it naturally commands a high price. But, inasmuch as the aconitine of Messrs. Hopkins and Williams commands as high a price, and is just as virulent, the above remark in this report is simply improper. The Messrs. Morson stand too high as manufacturers of alkaloids to need or wish for an indirect puff of this kind. We may here allude to another notice of a similar kind. "A granular composition, called Effervescing Citrate of Lithia, is exhibited by Messrs. Savory and Moore, and by Messrs. Wright, Francis, and Co.; that of the latter firm is stated to contain one grain of carbonate of lithia in each drachm, and to produce, when water is added, an agreeable saline draught." Now, both of these preparations are said to form an agreeable saline draught when water is added; and if it were necessary to say anything at all about the carbonate of lithia, it should have been added, that the preparation of Messrs. Savory is stated to contain *four grains* of carbonate of lithia in each drachm. These are slight blemishes in a paper, which is otherwise fair, and which certainly never errs on the side of excessive praise. Indeed, as we read it, we rather wonder how the Jury came to award any prizes at all.

We looked in vain for anything else to extract which will be interesting to our readers. They, perhaps, have never before heard of *Pereirine*, although it was not discovered yesterday, but in 1839. The exact source of the bark from which it is obtained has only recently been ascertained, and is now known to be derived from *Geissospermum Velosii*—order *Apocynaceæ*. It is obtained by treating the bark with acidulated water, and precipitating by ammonia, purifying afterwards in the usual way. It forms neutral salts, and the aqueous solution of a salt gives a deep crimson, with strong nitric acid. Little else is known about it.

How the resin of scammony root is obtained we presume all our readers know. They have read too lately all about the *Actea racemosa* root, and laraxinic acid; they probably are acquainted with the method of obtaining cod-liver oil, and are aware that pepsine is sometimes made from calves', sometimes from pigs', sometimes from sheep's stomachs, and sometimes from all three, just as the makers can get supplied; and, further, that it is sometimes sold with starch, and sometimes without; and, we may add, that "pepsine" sometimes contains no pepsine at all, but is said to be a mixture of cheese and starch, with a few drops of hydrochloric acid.

We extract the concluding remarks in the report, not because we entirely agree with all of them. For instance, we do not believe that so much of the improvement in British pharmacy is due to the Pharmaceutical Society. It would be about as correct to say that much of the improvement in chemical manufacturing is due to the Chemical Society. The Pharmaceutical Society has done a little, but probably not a tithe of what might have been accomplished if the Society had continued in the broad path on which it started, and had not degenerated into a weak imitation of the medical corporations in the attempt to make pharmacy a close profession.

"Pharmacy, as a distinct art, can rarely claim any great discoveries; and its advancement, of which we think the present Exhibition affords satisfactory evidence, is largely due to the increased knowledge which the labours of the scientific and manufacturing chemist have brought to bear upon it. Although we cannot but admit the importance of the services which chemistry has rendered, and is constantly rendering to the art of pharmacy, it is interesting to observe that, even in those departments in which the pharmaceutist has to rely more upon his practical experience than upon his theoretical knowlege, we are not without evidences of progress. Organic chemistry, indeed, has advanced during the last eleven years with rapid strides, producing, among its many useful results, not a few from which medicine can derive advantage. The collections of active principles of vegetables in the present Exhibition have been observed by the Jury with the greatest interest. The magnitude and purity of the specimens exhibited, indicate manufacture on a large scale, which in its turn is evidence that the substances shown are prepared not merely for exhibition, but actually for sale.

"Much of the improvement which British pharmacy has undergone is due to the Pharmaceutical Society of Great Britain; it is not, indeed, too much to say, that the exertions of this body during the past twenty years have contributed more than any other cause to raise the character and improve the attainments of the pharmaceutists of this country. Nor is improvement confined to Great Britain or even to Europe; it is, on the contrary, observable in the exhibitions of every country; and although pharmacy is but a small area for art and science, and can afford but an indifferent criterion whereby to judge of national progress, we think that its development, as evinced by the present Exhibition, is not without value as an indication of the advancement of science, and of the diffusion of the arts of civilization dependent upon it."

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

1958. James McGeary, Bayham Terrace, London, "Improvements in the manufacture of gas, and the apparatus to be employed for that purpose."—Partly a communication from E. L. Norfolk, Salem, Massachusetts, United States.—Petition recorded July 7, 1862.

2355. François Theophile Moison. Rue Gaillon, Paris, "Improvements in the process of cleaning organic matter."—Petition recorded August 23, 1862.

2934. Alexander Guild, Horbury Gardens, Notting Hill, London, "Improved apparatus for preparing and treating the leaves and stalks of fibre-yielding plants, and for cleaning and dressing the same."—Petitions recorded October 30, 1862.

2960. Evans Hopkins, Clarendon Gardens, Maida Hill, Middlesex, "An improved mode of, and apparatus for, treating ores for the extraction of metals therefrom."—Petitions recorded November 1, 1862.

2988. Arthur Wall, Cannon Street, East India Road, Poplar, Middlesex, "Improved processes for purifying lead, and extracting and separating silver therefrom, and in machinery for those purposes."—Petitions recorded November 4, 1862.

Notices to Proceed.

1973. Alfred Gilbey, Oxford Street, London, "Improvements in apparatus for washing and cleansing bottles."

1974. Henry Saltmarsh Pontifex, Banbury, Oxfordshire, "Improvements in apparatus for distributing water, applicable to cleansing casks or other vessels, or for other purposes."

1977. Hermann Eschwege, Mincing Lane, London, "Improvements in purifying wood and other vinegar."—Petitions recorded July 9, 1862.

2023. Paul Antoine Lucien Canonicat, Marseilles, France, "Improvements in filtering water, and in apparatus employed therein."

2026. Oliver Perry Drake, Massachusetts, United States, "A new or useful and improved apparatus for vaporising and aërating a liquid hydrocarbon, to be burned for illumination or for other purposes."

2035. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment or preparation of British and foreign algæ, and the application of the same to various branches of the arts and manufactures."—Petitions recorded July 15, 1862.

2061. Richard Archibald Brooman, Fleet Street, London, "Improvements in revivifying animal black in apparatus employed therein, and in recovering a product employed in the revivification."—A communication from Absalon Hippolyte Leplay and Jules François Joseph Cuisinier, Paris.

2249. Alfred Joseph Martin, High Street, Bow, James Gooss, Prospect House, Bow Road, and John Bush, Bow Common, Bromley, Middlesex, "Improvements in apparatus for distillation."—Petition recorded August 11, 1862.

CORRESPONDENCE.

Secrets from the British Pharmacopœia.

We have received several letters on the above subject, but as all take the same view of the matter we did ourselves, it is unnecessary to publish them. There are, however, some remarks in the communication of M. P. S. (London), which it is right to extract. He writes:

"I do not complain of the competition to which such as I must be exposed from houses with 'historic names.' I hope to found a historical reputation for my

own establishment, the fruits of which I hope my descendants will reap, and remember me with gratitude and love. Nor am I disposed to complain when a man is helped by his friends by all fair means. I am happy to say that more than one medical man is kind enough to recommend his patients to me, and I do not believe that they suffer either in health or pocket from the recommendation. I do object to private formulæ, and do not encourage them; and I cannot endorse Dr. Edwards' opinion, that when a name is placed on a prescription, no one else has a right to it. I wish patients to be as free to choose their druggist, as they are to choose their medical attendant. But with all these concessions, I do believe the cases you assisted to expose to have been most unfair transactions. The right of every medical man, every druggist, and, indeed, every Briton, to an equal interest in the British Pharmacopœia is unquestionable. If such a practice were to be allowed, it might as well be that only a few druggists should be permitted to have the formulæ, and these might be given, as monopolies were in years gone by. Those with court interest might then reap the natural reward of their position. But those days are past, and now I hope never again to hear that formulæ from the British Pharmacopœia have been prescribed, until the book is fairly before the public."

"*Question for Chemists.*"

To the Editor of the Chemical News.

Sir,—I feel much obliged to your ingenious correspondent, K. K., for his answer to my question. The results I obtained myself, and which so much excited my interest, were simply nitrate of ammonia, mercury, and magnetic oxide of iron—results which your correspondent will have no difficulty in formulating. He is probably right about the decomposition at a boiling heat: my own experiment was made considerably under.

I am, &c. ***

"*Miller's Physics.*"

To the Editor of the Chemical News.

Sir,—Allow me to call your attention to an error in one of our leading text-books.

In "Miller's Physics," page 199 of 2nd edition, you will find the following formula :—

The standard pressure.		The observed pressure.		The observed weight.		Corrected weight.
As H	:	H'—h	: :	W'	:	W.

But since density is directly as pressure, and weight directly as density, it is obvious that the formula is incorrect.

It should stand thus—

H'—h : H : : W' : W.

This example will show the error that this transposing of terms would cause.

Suppose, in Regnault's experiment, 600 cubic inches of air at a pressure of 28 inches of mercury (this being the result of deducting the residual elasticity from the barometric pressure at time of experiment) be found to weigh 173·236 grains—

H'—h : H :: . 173·236 : x; that is

28 : 30 :: 173·236 : x;

$\therefore x = 185{\cdot}61$ grains.

But if the formula be used, then—

H : H'—h :: 173·236 : x;

$\therefore x = 161{\cdot}68693$.

Thus, the weight of the air would give a result nearly 13 per cent. less than its real weight.—I am, &c.

Teuto.

Estimation of Copper.

To the Editor of the Chemical News.

Sir,—In reply to your correspondent, signing himself "Subscriber," I can assure him that no better process can be desired than that described in this journal for the 8th inst. I have made a point of fully investigating the process with reference to the complicated ores of copper, with a view to insertion in my "Handbook of Volumetric Analysis," now in course of publication by Mr. Churchill. Mohr's original paper is to be found in the *Zeitschrift für Analytische Chemie*, Part 2, and, though not at all lengthy, is more explicit than the extract from the *Répert. de Chimie*. Some little care and dexterity of manipulation are necessary to ensure the best results, but the accuracy and rapidity of the process amply repay this. I will give, as an instance, one of my own experiments:—10 grains of pure metallic copper were put into a porcelain capsule, together with about 5 grains each of the following substances, either as metals or salts, viz., gold, silver, platinum, tin, lead, iron, zinc, nickel, cobalt, bismuth, arsenic, uranium, mercury, molybdenum, antimony, sulphur, silica, and phosphate of lime. The whole was then treated with nitric and sulphuric acids, as described; then, after filtration with zinc, in a large platinum crucible. The yield of pure copper was 9·96 grains; the time occupied five hours. With all ores of copper, without exception, the results may be equally, or even more exact.

I am, &c. Francis Sutton, F.C.S.

Eastern Counties Laboratory, Bank Plain, Norwich.

MISCELLANEOUS.

UNBRANNING OF WHEAT.

In the report on the alleged grievances of the journeymen bakers, made by Mr. H. Seymour Tremenheere, to the Secretary of State for the Home Department, a process of unbranning wheat is described, which seems likely to exercise an important bearing on the supply of food. Messrs. Hadley, of the City Flour-mills, state to Mr. Tremenheere as follows :—

"We have been making experiments for some time on the mode of unbranning wheat, invented by Mr. Bentz about the year 1846, in America, and subsequently patented. The object of this process is to separate the outer cuticle, which is wholly innutritious, from an interior section of the wheat-berry, which contains mostly nitrogenous matter, and which has hitherto been lost as human food.

"There are two leading advantages in this process. First, the cleanliness of the flour produced. In grinding by the ordinary process it is impossible to render the flour entirely free from dust and dirt. After putting the wheat through two or three processes of cleaning in the common way, there will still be some dirt remaining in it. All flour always contains more or less of this dust. There is also a portion of the beard of the wheat, a kind of fibrous appendage, which is always ground up with it; no process hitherto known has been able to get rid of it.

"By Mr. Bentz's process, as the exterior cuticle is entirely removed previously to grinding, the flour is necessarily perfectly clean, and free both from dust and this fibrous down.

"Secondly, by the ordinary mode of grinding, the result obtained is 76 per cent. of flour for human use. By the new process we find, after a series of very careful experiments, extending over several months, that we obtain about 86 per cent. of the whole berry available to make bread.

"The money value of this increase of 10 per cent. is subject to a deduction of about one-half in consideration of the lessened quantity of offal, the value of which we may take at half of that of the flour if used as human food. The offal is used for many purposes, which give it a value larger than would at first sight be conjectured.

"In addition to this net increase of 5 per cent. in value of flour available for human food, the flour made by this

process, containing all the nitrogenous or nutritious matter existing in the berry hitherto lost, yields a large increase in the number of loaves per sack. From the trials which we have ourselves made, we are satisfied that that increase may be safely stated at 20 lbs. of bread per sack of flour. This, taking the common average yield of a sack of flour at 90 four-pound loaves, or 360 lbs. of bread, amounts to an increase of upwards of 5 per cent. on the bread (18 lbs. would be exactly 5 per cent.)

"The aggregate gain in flour and bread may, therefore, safely be stated at 10 per cent.

"There is also another source of gain in a national point of view, in the increased nutritive value of the whole mass of the flour made by this process."

Dr. Dauglish, whose paper descriptive of his process of making aërated bread was read before the Society of Arts, in reference to this method of unbranning, states as follows:—

"The invention was brought under the notice of the French Emperor, who caused some experiments to be made in one of the French bakeries, to test its value. The experiments were perfectly satisfactory, so far as the making of the extra quantity of fine flour was concerned; but when this flour was subjected to the ordinary process of fermentation, and made into bread, much to the astonishment of the parties conducting the experiments, and of the inventor himself, the bread was brown instead of white. The consequence, of course, has been, that the invention has never been brought into practical operation. But, about four years ago, a French chemist, M. Mége Mouriès, directed his attention to the subject of utilising, for the purpose of white bread-making, the nutritious substances ordinarily thrown away with the bran, and the results of his inquiries were communicated in a memoir to the Academy of Sciences, on June 9, 1856, and have since been reported on by MM. Dumas, Pelouze, Payen, Peligot, and Chevreul.

"These results explain most satisfactorily the cause of failure of the flour prepared by the American method to make white bread.

"Before the publication of M. Mouriès' researches, the nutritious substance attached to the bran was considered by chemists to be a portion of the gluten of the grain, but it now proves not to be gluten at all, but chiefly a new nitrogenous body, analogous to gluten, which the discoverer has named 'cerealine,' with a portion of another well-known nitrogenous body—'vegetable caseine.'

"Among the properties of this body, cerealine, M. Mouriès gives the following:—

"It is soluble in water, and insoluble in alcohol. It acts as a ferment on starch, dextrine, glucose, or grape sugar. It alters gluten extremely, and gives to the altered matter a brown colour. Its peculiar action, when brought into contact, in the process of fermentation, with the ordinary constituents of fine white flour, is the true cause of the dark-brown colour imparted to the bread made from flour in which the cerealine was retained.

"M. Mouriès, having satisfied himself as to the properties of cerealine, adopted a method by which its peculiar action was neutralised, and then made bread by the ordinary process of fermentation, in which the whole of the bran contained in the internal coat of the grain was allowed to remain. The result was a loaf having merely an orange colour, but none of that dark-brown colour which always results when the bran contained in the internal coat of the grain is used in bread made by the ordinary method.

"In like manner, by my process, in which the fermentative changes are never allowed to take place, bread made from wheaten meal, from which only the coarse bran has been separated, is so free from the dark-brown colour that it is difficult to persuade people that it is made from wheaten meal at all."

HONOURS TO CHEMISTS.

We are happy to announce, that this year the labours of chemists have received more recognition than usual at the hands of the Societies which have honours to confer. Mr. Graham receives the Copley medal of the Royal Society for his researches on the "Diffusion of Liquids," on "Osmotic Force," and the recent and important application of the results of his investigation, "Liquid Diffusion applied to Analysis." The importance and value of Mr. Graham's researches are yet, perhaps, but insufficiently appreciated; but every one will congratulate the Royal Society on the award of this medal.

One of the Royal medals is assigned to Professor Williamson for his researches on "Organic Chemistry," and into the "Nature of Compound Ethers." We have not heard much of Professor Williamson of late, but hope he will be stimulated by the medal to continue his investigations. The Rumford medal has been conferred on Professor Kirchhoff for his researches on "Spectrum Analysis." To this award, no English chemist, we imagine, will object.

At the meeting of the Society of Arts, on November 19, Sir Thomas Phillips presented the Society's silver medal to Dr. F. Crace Calvert, F.R.S., for his paper on the "Improvements and Progress in Dyeing and Calico Printing since 1851." Another silver medal was presented to Mr. E. C. C. Stanford, F.C.S., for his paper on the "Economic Uses of Sea-weed." We do not remember that the Society of Arts has ever given a medal where it was so well deserved as by Mr. Stanford. The labour spent in prosecuting the experiments, the results of which were detailed in the paper, will bring the author, we hope, still more substantial reward.

Testimonial to Mr. C. W. Quin.—A subscription was commenced some time ago among the exhibitors in Class 11 in the International Exhibition, for the purpose of presenting a testimonial to the obliging and indefatigable superintendent of the department, Mr. C. W. Quin. The movement has our warmest support. The amount of each subscription was fixed at one guinea, and we are happy to hear that most of the exhibitors have cordially responded to the call. The form of the testimonial has not yet been decided on.—Mr. S. L. Howard, Chemical Works, Stratford, is the Chairman, and will receive subscriptions.

Patent Law Commission.—The Royal Commission on the Patent Law, obtained last session by Sir Hugh Cairns, held their first sitting on the 19th inst. Lord Stanley was chosen for chairman.

Chemical Society.—At the next meeting of the Chemical Society the following papers will be read:—Dr. Woods, "On the Determination of Organic Matter in Drinking Water;" Mr. Rodwell, "On the Reactions of Sulphate and Sulphide of Lead with Hydrogen and Carbonic Oxide."

ANSWERS TO CORRESPONDENTS.

Inquirer.—We have not met with much success with aluminium.

Received—E. G., M. P. S., E. D., G. Darwin, M. P. S. (Edinburgh).

J. C.—The smell cannot be removed.

B. W.—It is done by one or two rectifications collecting the product which distils between 80° and 85° C.

Sapo Mollis.—Would Fuller's earth answer your purpose, or China clay?

M. B.—We have not seen the formula, but we should think it would be published in the next *Pharmaceutical Journal*.

Radical.—An account of all the theories will be found in the seventh volume of Gmelin's "Chemistry."

A Subscriber.—Permanganates can be obtained at the operative chemists'. Mr. Condy, of the Battersea chemical works, manufactures and prepares them in quantity at a very reasonable price. See advertisement.

J. P. A.—One plan adopted for combining oxygen with oil is, boiling the oil in a cauldron with a little oxide of lead. Another plan is, to place a thin layer of oil on a plate of metal or glass, and expose it to a current of heated air. We are obliged to our correspondent for his suggestions, and can assure him that we never neglect to supply any information that comes in our way which is likely to prove profitable, commercially, to our subscribers.

THE CHEMICAL NEWS.

VOL. VI. No. 157.—December 6, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analytical Notices on Cyanogen, by M. H. ROSE.

Estimation of Cyanogen.—In estimating the metals contained in cyanogen combinations, it is often necessary to destroy or to completely expel this radical. This is done by calcination; but it is sometimes necessary to heat the cyanide for some time in contact with the air, and the platinum crucible is in some instances strongly attacked. It is better to treat the given body, by excess of concentrated sulphuric acid, with a little water, and to heat the mixture long enough to get rid of nearly all the excess of sulphuric acid. The operation should be conducted in the following manner, because certain cyanides dissolve in concentrated sulphuric acid, forming with it a combination precipitable by the addition of a small quantity of water, and soluble in a larger quantity of this liquid. All cyanides, simple and double—even cyanide of silver, as well as nitroprussiate of soda and the sulphocyanides—are transformed, by this process, into sulphates, which present no difficulty in estimating the metals.

No advantage is gained by replacing sulphuric acid by the acid sulphates of ammonia and potash. On the other hand, the use of sulphate of mercury, or of subsulphate, Turbith's mineral, yield very good results. With the addition of carbonate of ammonia, the cyanated metals are obtained in the state of oxides, as, for instance, in the combinations of cyanide of potassium with ferrous and ferric cyanides. By treating the residuum with water, all the potash is extracted in the state of sulphate, and the peroxide of iron remains perfectly pure, as is the case only when carbonate of ammonia is used.

The other methods proposed, as, for instance, fusion with a mixture of carbonate and nitrate of potash, or, rather, with nitrate of ammonia or mercurial nitrate, are far less advantageous.

Transformation of Cyanogenated Combinations into Chlorides by means of Hydrochlorate of Ammonia.—M. Rammelsberg has analysed combinations of alkaline cyanides with gold, platinum, palladium, and iridium, by decomposing these salts with chlorine. The greater portion of cyanogen combinations are convertible into chlorides by calcination in a closed porcelain crucible, with excess of hydrochlorate of ammonia. In some cases, the metallic chloride may volatilise, but if the calcination is conducted with hydrochlorate of ammonia, in a hydrogen current, we obtain, in many instances, the reduced metal mixed with the alkaline chloride, which could be easily removed by water, and the reduced metal weighed, after re-calcination in a hydrogen current. This process is applicable to cobalticyanide of potassium, but is less so for alkaline ferricyanides and ferrocyanides, the metallic iron which remains containing carbon.

Estimation of Cyanogen in the State of Cyanide of Silver.—This is the best, and may, indeed, be called the only process for directly estimating cyanogen; but there are only a few cyanides, alkaline cyanides, for instance, which give a direct precipitation of cyanogen by nitrate of silver. The operation is thus conducted:—Cover the solid cyanide with a solution of nitrate of silver, and then with water and a certain quantity of nitric acid; care must be taken not to add too large an excess of nitric acid, cyanide of silver being more soluble in nitric acid, especially with heat, than the chloride. Weigh the cyanide of silver, dried at 100° on a weighed filter, or, better still, calcine it at a moderate temperature, so as to avoid melting the silver, until it ceases to lose weight.

This process applies to double cyanides containing metals whose cyanides are soluble in nitric acid; to those of nickel, copper, and zinc, for instance.

Analysis of Mercuric Cyanide.—It is well known that cyanogen cannot be precipitated, in the form of cyanide of silver, from a solution of mercuric cyanide. A crystalline combination of cyanide with nitrate forms, soluble in excess of water. The mercuric cyanide is decomposable by sulphuretted hydrogen, with the addition of a salt or of ammonia to favour the precipitation of sulphide of mercury, and to weigh the sulphide. The mercury, also, can be precipitated in a metallic state by phosphorous acid, or, better, in the state of protochloride by hydrochloric and phosphorous acid; but these two methods, and especially the latter, do not invariably give correct results. Though it is easy to determine in this way the mercury of mercuric cyanide, it is much less easy to estimate the cyanogen in this salt. After numerous experiments, M. Rose has arrived at the following process, which yet leaves something to be desired:—He adds hydrate of potash to the solution of mercuric cyanide, then sulphuretted hydrogen, taking care to avoid any excess of the latter. To this mixture is then added a solution of oxide of zinc in potass, and the cyanogen is precipitated in the filtered liquid by nitrate of silver, in presence of a certain quantity of weak sulphuric acid.

The solution of oxide of zinc can also be added to the mercuric cyanide, before the mercury is transformed into sulphide; in which case there is formed, simultaneously with the decomposition of the cyanide of mercury, a double cyanide of zinc and potassium, with difficulty decomposed by sulphuretted hydrogen. On the addition of a quantity of oxide of zinc sufficient to withdraw the sulphuretted hydrogen, the cyanogen will be entirely dissolved as double cyanide. The mixture of sulphides is washed with weak ammonia, and precipitated by nitrate of silver with addition of sulphuric acid.

The potash might be replaced by a solution of ammoniacal nitrate of zinc, proceeding then as above described.

Estimation of Cyanogen in Mercuric Cyanide by means of Cadmium.—Cyanogen can be estimated in mercuric cyanide by dissolving this salt in twenty-five or thirty times its weight of water, and by leaving the solution in contact with an equal weight of cadmium filings in a well-stoppered bottle. After about thirty-six hours, add nitrate of silver and nitric acid; almost exactly the theoretical quantity of cyanide of silver is then obtained.

A small quantity of cyanide of cadmium is deposited on the sides of the vessel, which must be dissolved in acetic acid, and added to the above solution. Mercury cannot be exactly determined in the residuum.

Zinc and iron decompose mercuric cyanide very incompletely.

Cyanide of silver is not decomposable by zinc in presence of water, and with difficulty on the addition of an acid.

Decomposition of Cyanides by Oxide of Mercury.—The author attaches great importance to the analysis of cyanide of mercury, because a large number of simple and compound cyanides are easily transformed into cyanide of mercury. To effect this change it is necessary only to boil them, in solution or fine powder, with excess of oxide of mercury. The metal of the cyanide separates in the state of oxide, and the cyanogen forms, with the mercury, mercuric cyanide.

In analysing cyanuretted combinations of iron, it is necessary to add, before filtering, sufficient nitric acid to nearly neutralise the liquid; without this precaution it is almost impossible to filter the liquid.—*Poggendorff's Annalen.*

Scarborough Spa—Analysis of the Water of these Mineral Springs, by Dr. Sheridan Muspratt, *M.D., F.R.S.E., M.R.I.A., Founder and Principal of the College of Chemistry. Liverpool.*

The reason that induced me to re-analyse the waters of the Scarborough Spa, was principally on account of reading the following in Dr. Granville's famous work upon "The Spas of England." He writes:—"I find it laid down, that of *five* successive analyses which had appeared in the course of two-thirds of a century, there was not *one that did not differ from the rest in every essential particular.* . . . . Thus, insensibly, was the confidence of the public shaken in the real composition of the Scarborough waters, and, by a natural consequence, the confidence also in their medical virtues." It is now a great number of years since Professor Phillips published his analyses of these springs; but even with the results of this able chemist mine are greatly at variance, for he assigns—and on his statements medical men have for a long time prescribed—to the South spring the greater aperient properties; whereas, I have recently proved, by repeated determinations, and by the effects of the two waters upon individuals, that the North possesses more laxative salts,—sulphate of magnesia, carbonate of magnesia, &c. This being the case, I have deemed it my duty to forward you this paper for insertion in your valuable columns. The new analyses may prove serviceable to physicians and others interested in the matter, or who may be sending patients to partake of a course of the waters. Before tabulating the results, I must remark, with respect to the iron in the springs, that, contrary to all previously published data, the North contains the *smaller* proportion of this metal. Mr. Phillips gives the *same quantity* of iron in each water.

The contents of an imperial gallon are as under:—

Mineral Springs.

	North. Cubic inches.	South. Cubic inches.
Nitrogen . . .	7·4864	7·9792
Carbonic acid . .	43·3112	38·0408

Mean temperature of the water, 48°.

	Grains.	Grains.
Carbonate of lime .	42·354	34·846
Carbonate of magnesia	2·844	3·051
Carbonate of iron .	1·465	1·996
Carbonate of manganese	trace.	trace.
Sulphate of magnesia	98·952	90·992
Sulphate of lime .	69·120	69·537
Sulphate of soda .	7·060	2·015
Chloride of sodium .	19·287	19·540
Chloride of potassium	3·002	2·416
Chloride of magnesium	1·941	0·920
Silicic acid . .	·859	1·063
Organic matter, &c. .	traces.	traces.
	246·884	226·376
Sp. gr. of the water .	1·0033069	1·0028378

The carbonates of the earths and iron are, of course, held in solution by carbonic acid, existing, therefore, in the state of bicarbonates, the quantity of which, in cubic inches, being given above, irrespective of that in combination, and tabulated as neutral carbonates.

College of Chemistry, Liverpool, November 25.

On the Artificial Formation of Populine, and on a New Class of Organic Compounds, by Dr.* T. L. Phipson, *F.C.S., &c.*

The interesting substance, populine, was extracted in 1830, by Braconnot, from the mother-liquors which had deposited salicine, when the latter was obtained from the leaves of the poplar tree, *Populus tremula.* In 1852 Piria showed that in a variety of circumstances populine split up into benzoic acid and salicine. Dr. Phipson shows that salicine and benzoic acid combine, equivalent for equivalent, to form populine,—

$$\underset{\text{Benzoic acid.}}{C_{14}H_6O_4} + \underset{\text{Salicine.}}{C_{26}H_{18}O_{14}} = \underset{\text{Crystallised populine.}}{(C_{40}H_{22}O_{16} + 2\,HO)}$$

This occurs when the two substances are dissolved together in alcohol, and the solution made to crystallise; the properties of the artificial compound being precisely identical with those of the natural product. Its peculiar taste—acrid and sweet at the same time, reminding us of the taste of liquorice—is characteristic. With sulphuric acid it takes a red colour, and with bichromate of potash and sulphuric acid it gives, on heating, salicylous acid. In this combination salicine has lost its bitter taste, which renders it probable that populine is a compound of benzoic acid, sugar, and saligenine; for, when boiled with dilute sulphuric acid, it breaks up into benzoic acid, sugar, and saliretine (saligenine *minus* aqua). The molecule of populine is, therefore, a very complex one; and these kinds of compounds may perhaps be compared to the combinations of two or more salts in mineral chemistry,—for instance, to alum, if we compare the sulphate of alumina to the benzoic acid, the sulphate of potash to the saligenine, and the twenty-four ounces of water to the sugar.

The author goes on to state that he has obtained similar compounds with tartaric and citric acids. He

* Read before the British Association.

states that when these two acids are taken in equivalent proportions, dissolved in water, and quietly evaporated, they enter into chemical combination. It is well known that these acids crystallise in two different systems, the forms of which are incompatible; and by evaporating a mixture of them, we should obtain two kinds of crystals if no combination took place; but the author finds that they do combine, and produce one kind of crystal only,—namely, long, prismatic needles, and when one of these needles is taken and analysed, it is found composed of citric and tartaric acids.

"This combination of citric and tartaric acids," says Dr. Phipson, "is probably only one example of a new class of organic compounds, similar in some respects to populine, which remains to be studied. Already Professor Williamson has shown that the different acetones may be made to combine so as to produce complex acetones. Thus, when valerate and acetate of lime are distilled together in equivalent proportions, we obtain aceto-valerone,—a compound of acetone and valerone, and so on for the others. It is highly probable that other organic acids, besides benzoic acid, may be made to combine with salicine; likewise, that other bitter principles analogous to salicine may be combined with organic acids to produce substances similar to populine."

TECHNICAL CHEMISTRY.

On the Preparation of Hydrobromic Acid, by JOHN M. MAISCH.

HAVING repeatedly had occasion to prepare hydrobromic acid, I embraced the opportunity to try various processes, recommended at different times by several chemists.

Glover's process consists in decomposing a solution of bromide of barium by diluted sulphuric acid. If sufficient care is bestowed upon it, there is no great difficulty in obtaining the acid free from both sulphuric acid and baryta. If distillation is resorted to, a very slight excess of sulphuric acid is advisable. The result is a good one, but the process is inconvenient, as it renders necessary the previous preparation of bromide of barium.

Loewig recommended to distil 4 parts of bromide of potassium with 3 parts of sulphuric acid and 48 parts of water. Various inconveniences are connected with this process. In the first place, the quantity of water is too large; the first portions of the distillate contain no acid, and do not redden litmus paper; gradually, as the liquid in the retort becomes more concentrated, the acid makes its appearance among the vapours, until, towards the close of the process, the main part of the hydrobromic acid distils over. Now, however, another inconvenience arises. Owing to the separation of sulphate of potassa, a violent bumping takes place, which endangers the safety of the retort. The quantity of sulphuric acid directed shows that the formation of bisulphate of potassa is intended, for which, however, there is a deficiency of 0·40 parts $HOSO_3$. If this amount is added to the contents of the retort, the concussions are materially diminished, so that the distillation may with greater safety be continued. But a reaction takes place between the concentrated sulphuric and the hydrobromic acids, resulting in sulphurous acid and bromine, both contaminating the distillate. The quantity of these impurities will be lessened with a decrease of the sulphuric acid. Balard first took notice of this fact, and also made the observation, that the gaseous acid prepared from the same materials in the proportion mentioned, omitting the water, is obtained purer in proportion to an increase in the size of the crystals of bromide of potassium.

When bromine, diffused in water, is treated with gaseous hydrosulphuric acid, as recommended by Balard, the product contains sulphurous acid, which, according to Loewig, is due to the formation of bromide of sulphur and its subsequent decomposition by water.

Millon uses a mixture of 1 p. phosphorus, 12·5 p. bromine, 7·8 p. bromide of potassium, and a small quantity of water. He directs the mixture to be heated, but I have found the reaction far too violent even without the external application of heat. If some precautions are adopted, the process is a good one, and I shall speak of it again hereafter.

This last process is a modification of the one originally suggested by Balard, to carry out which Loewig directs to add to the phosphorus immersed in water the bromine in small quantities at a time, in order to avoid too violent a disengagement of heat, and to continue the addition of bromine until the whole of the phosphorus has disappeared (Gmelin's Chemistry, Cavendish edit. ii. 281). After each addition of bromine, sufficient heat will be generated to keep the phosphorus in a state of fusion, and the reaction is sometimes so sudden and violent as to throw small portions of it above the water, where they burn in the atmosphere, composed of aqueous vapours, hydrobromic acid, and bromine. Notwithstanding this great affinity of the two elements, the liquid has a brown colour from containing some free bromine in solution, which increases in quantity with the hydrobromic acid contained in the mixture, probably forming therewith hydrobromous acid, HBr_2. This solution is not so readily acted on by phosphorus, for the complete solution of the latter requires a considerable excess of bromine, particularly if the water in the mixture has been unnecessarily increased. It is better, therefore, to have both the elements weighed out in the equivalent proportion, namely, 1 part of phosphorus and 12·5 parts of bromine, the last of which is about ·16 parts less than the equivalent weights require.

I have worked with the following apparatus, which I have found to answer very well. A funnel tube is fitted into the tubulus of a retort capable of holding at least double the amount of all the materials. The retort is placed with the neck pointing upwards, and connected with an empty receiver by means of a glass tube, which is cut off just below the cork; a second glass tube, commencing near the bottom, connects this receiver with another one of the same capacity—any ordinary bottles will answer—and dips into a little distilled water, both receivers being kept cool by ice, or some other means.

The phosphorus is first introduced into the retort, together with six or eight parts of water, or more if desired. The bromine must be added only in small portions at a time through the funnel tube, which is immediately afterwards covered with a glass plate. The apparatus is soon filled with white vapours of hydrobromic acid, mixed sometimes with free bromine. The vapours are partly condensed in the neck of the retort, and run back; they partly condense in the first receiver, while the last portions are absorbed by the water in the second bottle. This liquid will commence to rise in the tube when the reaction has subsided, and more bromine must now be added. This is continued from time to time until the whole has been used.

The first receiver generally contains some free bromine, beside some hydrobromic acid. The liquor in the last receiver will mostly be colourless, if the condensed liquor from the first one has not been forced over through the

connecting tube. If colourless, it is set aside and employed as the absorbing liquid in the next part of the process; if coloured, it is, together with the contents of the first receiver, added to the residue in the retort, and the whole apparatus is then set aside, if possible, in the direct sunlight. The retort now contains phosphorus, bromine, phosphoric and hydrobromic acids. When it has become colourless after exposure to the light and occasional agitation, the bromine has been converted into hydrobromic acid.

The next step is the distillation of the hydrobromic acid, previous to which, however, every trace of uncombined phosphorus is to be removed. The neck of the retort is inclined, and the glass tube, after the first receiver has been disconnected, is made to dip into a small quantity of distilled water, or into the liquid employed during the first part of the process, if it was colourless, and had not to be subjected to another distillation. Heat is applied, and the distillation continued to near dryness, or until the residue ceases to liberate bromine, when a drop is added to a little chlorine water. The residue constitutes pure phosphoric acid.

In this process, pentabromide of phosphorus is first formed, which decomposes water when coming into contact with it, yielding phosphoric and hydrobromic acids. Inasmuch as concentrated phosphoric acid is apt to gradually destroy the retorts, it will be well to add, after the undissolved phosphorus has been removed, 5·9 parts of bromide of potassium, and distil to dryness. As the solution in the retort becomes concentrated by distilling off the liquid, a double decomposition is effected, resulting in the so-called neutral phosphate of potassa, $2KO,HO,PO_5$ and hydrobromic acid, the former of which is very soluble in water, and does not in the least impede the process. When the concussions are observed, the fire is to be removed and the tubulure opened, the salt becomes solid, and may, by dissolving in water and evaporating in a capsule, be obtained in a dry state. It is a pure phosphate if the phosphorus did not contain any impurities.

The 5·9 parts of bromide of potassium increase the 12·5 parts of bromine to 16·5 parts, and thereby the strength of the resulting acid may be calculated. Weighing out the above parts in drachms, I have diluted the acid obtained to 16 fluid-ounces, so that each fluid-ounce contains rather more than one drachm of hydrobromic acid.

Before concluding, I will draw attention to the precaution, never to add the phosphorus to the bromine, inasmuch as the affinity of both elements is so great that the phosphorus burns in the vapours of the bromine, causing violent explosions, which may shatter the apparatus to atoms. By proceeding in the manner described by me, there is no danger connected with the operation, and the only annoyance is caused by the volatilisation of a little bromine while pouring it into the retort.

PHARMACY, TOXICOLOGY, &c.

Pharmaceutical Matters in America, by Edward Parrish, *Philadelphia.*

It is a subject of remark by pharmaceutists in the United States, that their contributions to knowledge are less sought out and copied into the English and Continental journals than the interest and importance of some of them seem to demand. It is not pretended that this eminently practical and utilitarian nation adds so large a quota to the scientific stock as do communities in which science occupies a long-established eminence, and is continually fostered by wealth and power; and yet the practical tendencies of the American people, and the vast field which their continent opens to original research, enable them to aid materially the cause of general science, and especially to add to the resources of the physician and pharmaceutist.

Voluntary association chiefly supplies among us the stimulus to scientific effort, which legislation and government patronage and the aid furnished by ancient endowments give to European science. Organisation has become a recognised necessity in almost every profession and craft in the United States. We inherit the well-known facility exhibited in the mother country for combined effort, and the consequences are a vast increase and diffusion of intelligence in every department of professional effort.

Of course, the rebellion, and the war for its suppression, have produced sad breaches in many of our national organisations. Some of them are suspended outright, while others have gone into a state of temporary inefficiency. The pharmaceutists have maintained their vitality, perhaps, as well as any of them. The local colleges of pharmacy, all of which are situated in the loyal States, continue their courses of instruction to classes but little diminished; and our national organisation, the American Pharmaceutical Association, has just held one of its annual meetings, which, though not as largely attended as some of its predecessors, nor so productive of important results, has yet shown that war, with all its desolating effects, has not robbed at least one liberal profession of its zeal for professional and scientific progress.

The late anniversary was the tenth of the series, and was held in Philadelphia for the third time. The meeting projected at St. Louis, Missouri, a year ago, was postponed, having proved to be unfortunate in the selection of time and place. The intermingling of the leading members of the profession from remote localities, some of them living two or three thousand miles distant from each other, has many social and business advantages, besides the diffusion and increase of chemical and pharmaceutical knowledge. Professor William Procter, editor of the *American Journal of Pharmacy*, was elected president for the current year—a deserved compliment to one of the most laborious workers in the pharmaceutical field.

The chief report at this, as at previous meetings, was that upon the progress of pharmacy, written this year by Professor J. M. Maisch, of the New York College of Pharmacy. This paper gives a systematised view of the discoveries, observations, and contributions to knowledge in materia medica, pharmacy, and pharmaceutical chemistry for the past two years, including all those recorded in the English, French, German, and American periodicals, as far as practicable. As these are accompanied by references to the sources of more full information, and by numerous useful comments and critical remarks, this report is one of the most valuable guides to investigation that could be compiled, and, taken in connection with its predecessors, furnishes a complete exhibit of the progress of the science and art of pharmacy during the period over which they traverse. Some idea may be formed of the extent of the present report from its occupying 145 octavo pages of printed matter, of which pages a large majority contain references to from eight to twelve discoveries or other items of information.

Another feature of these meetings, of special interest

to the readers of such a paper as the Chemical News, is that of original essays contributed by members, either at their own suggestion or in answer to queries allotted to them at the previous annual meeting. Of these, several received this year are of considerable general interest, and I will endeavour to sketch the purport of some of them in advance of your receiving the printed proceedings.

The Active Principle of Veratrum Viride.—This subject is handled in a chemical and therapeutical paper by George J. Scattergood, of Philadelphia. It is well known that this root, which is one of the most popular sedatives in use, contains veratria, and it has been hence supposed that it must exhibit the peculiar irritative and poisonous properties known to belong to that vegetable alkali. On the contrary, it is the general testimony of physicians that it is comparatively innoxious, producing a certain and quite rapid reduction of the pulse, but without much prostration or excessive nausea. The results reached by the experiments now reported are—first, that the root contains but a minute proportion of veratria, 30 grains to the pound, and a comparatively large yield, 300 grains to the pound, of a "resinous principle," soluble in alcohol, and deposited on mixing the alcoholic fluid extract with water, which at the boiling temperature seems to dissolve out the native salt of veratria present. The veratria and resinous substance were separately administered to dogs; and while both the alkaloids and resin produced the characteristic symptoms of poisoning by veratria, the resin produced by far the most rapid and marked reduction of the pulse. This fact, taken in connection with the larger proportion of the resin in the root, seems to give the key to its true character, and to justify the daily assertion of its superiority over other arterial sedatives. It seems a remedy precisely adapted to substitute for bleeding, and as such a great desideratum. The action of the resin on the human system was also the subject of experiment: two grains produced a reduction of pulse from 80 to 55 in four hours, accompanied by vomiting, diaphoresis, and corresponding debility, from which, after sleep, the experimenter completely and readily recovered. There was no tingling of skin, a symptom described as pertaining to veratria. What the chemical nature of this so-called resinous substance is requires some further investigation, for we know the facility of organic crystalline principles to become changed into amorphous and extractive-like products, and analogy does not indicate that a resin should possess the therapeutic effects designated.

The Vegetable Alkalies in Hydrastis Canadensis and Xanthorrhiza Apiifolia.—This is the title of a paper presented at the meeting by Wm. S. Merrill, a manufacturer of pharmaceutical products in Cincinnati, Ohio. As long ago as 1850, Durand, jun., of Philadelphia, discovered a vegetable alkali in the root of *Hydrastis Canadensis*, and announced the fact in an inaugural thesis presented to the College of Pharmacy, though, not having facilities for an ultimate analysis, he proposed the name *hydrastin* only as a provisional one, in case its claims to be a distinctive alkaloid should be established.

In the meantime, the "eclectic physicians," a class of practitioners in the Western States who have done much to bring into notice our indigenous materia medica, pursuing a crude system of manipulation, which, with more facility than science, subjects all drugs to nearly the same treatment, had stumbled on a crystalline principle from hydrastis, to which, regarding it as a kind of resinoid, they applied the name *hydrastin:* this principle soon assumed a position among their established remedies, and is still largely employed, being styled, by one of their leading authorities, the "quinine of North America."

Professor E. S. Wayne, of Cincinnati, in 1856, in forwarding to Professor Procter some specimens for the Museum of the Pharmaceutical Society of Great Britain, included among them this "eclectic hydrastin," and a beautifully crystallised specimen of the distinctive vegetable alkali, hydrastia, as first isolated by Durand. The peculiar interest attached to the paper of Merrill, above referred to, lies in his claim to the discovery of this alkali, founded, as now appears, upon ignorance of the published experiments of Durand, and the unpublished ones of Wayne. During the past year, Professor Mahla, of the Chicago College of Pharmacy, has made a most unexpected discovery, which adds new interest to the eclectic preparation hitherto called hydrastin: he has proved it to be muriate of berberina; furnishing another instance of the same vegetable alkali occurring in totally different families of plants. To this interesting discovery, confirmed by the investigations of J. Dyson Perrins, as published in the *Pharmaceutical Journal* and *Transactions*, must be added that of the identity of the alkali of *Xanthoriza apiifolia*, with the berberina derived from hydrastis, and that originally described by M. Buchner, sen., and Son, as the product of *Berberis vulgaris*.

The most ready mode of preparation of these products from the root of *Hydrastis Canadensis* appears to be that of Professor Wayne. He treats the coarsely-powdered roots with cold water by displacement, and to the infusion adds muriatic acids, which throws down acicular yellow crystals of muriate of berberina (hydrastin), along with a "pectin-like substance." The precipitate is now digested in boiling alcohol, which takes up the muriate, and deposits it in crystals upon cooling. The true hydrastia is now obtained from the acid liquor by saturating it with an alkali; it is then re-dissolved in alcohol or ether, and re-crystallised in "colourless, quadrangular prisms with very acute pyramidal summits." A remarkable difference between these separate principles is, that, while berberina is soluble uncombined, and only obtainable in crystals by combination with an acid, the true hydrastia is insoluble when uncombined with acids, and only obtainable by neutralising the acid with which it is associated in the root. Therapeutically, berberina possesses well-known tonic properties, but I am not aware of any experiments on the uses of the new vegetable alkali, hydrastia; indeed, until now, it has been only a curiosity found, though but rarely, in cabinets. An observation which it occurs to me to make in this connection is this:—Our American system of naming the vegetable alkalies invariably gives them a termination in *ia*, as in ammonia, reserving the termination *in* for neutral and resinoid principles; by this means we think we have a method of distinguishing them, which is an improvement on the nomenclature practised almost universally abroad.

Tests for the Vegetable Alkalies, especially in Extracts.—Professor F. F. Mayer, of the New York College of Pharmacy, to whom was referred the subject of the use of phosphomolybdic acid as a test in medicinal preparations, in his report treats of the use of this test, which he finds rather ineligible, partly from the test being decomposable by saccharine and extractive matters, and on account of the difficulty of distinguishing its reaction with vegetable alkali from that with ammonia.

He also furnishes some observations on the systematic quantitative testing of what are generally termed alkaloids, though I prefer, what appears to me, the more accurate designation, organic (vegetable or animal) alkalics.

Professor Mayer very properly prefers a volumetric method, to one involving the process of weighing, as the quantity of vegetable alkali in any medicinal preparation is necessarily small. He finds the iodohydrargyrates and bromohydrargyrates of the mineral alkalies, as first recommended by Von Planta in 1846, and by Thomas B. Groves in 1858, to answer his purpose best, and furnishes a table of equivalents adapted to this method.

A good quantitative test for this highly important class of active principles would be a great desideratum to the pharmaceutist, in view of the variety and uncertain character of the "galenical" preparations.

Of the remaining papers read at the late meeting of the Pharmaceutical Association, my space will hardly allow me to refer, though some of them were of considerable interest. "Statistics and Essays on Virgin Scammony," by Dr. E. R. Squibb, of New York, exhibiting the per-centage of resin in thirty-four lots of this drug imported into New York, show great variations of quality even in the purest commercial variety of this costly cathartic.

The remarks now made are respectfully submitted, without pretensions to novelty or to scientific merit, but to inform your readers on American pharmaceutical affairs.

On the Preparation of Artificial Mineral Waters.

THE preparation of artificial mineral waters is the subject of a report by MM. Chatin, Poggiale, and Lefort, who constituted a commission appointed by the Société de Pharmacie of Paris. It is at once admitted by the authors, that, in the present state of our knowledge, the exact imitation of a natural water is not possible; but it is also granted, that it is possible to compound artificial mineral waters, which shall be sufficiently close imitations of the natural waters to supply the place of these latter, within certain limits, both for drinking and bathing purposes. The Society proposes, therefore, to retain the artificial waters in the Codex, revised formula for their production being given, calculated from the latest and most approved analyses of the natural sources. We propose here to furnish our readers with the directions for the preparation of those which are most in use in this country, and also some of the remarks on the introduction of some particular substances.

The choice of a water to form the base of the artificial preparation is of importance. Water from the sedimentary rocks, in consequence of containing large amounts of lime salts, always furnish mineral waters, which soon become turbid. Soft water from rivers and granitic sources are, *cæteris paribus*, to be preferred. But, as M. Soubeiran observes, "the proportion of saline ingredients which must enter into the composition of an artificial water is calculated as though pure water was to be used. But, in fact, a spring or river water which always contains some saline matters in solution is made use of. When the amount of these is small, they need not be taken into account; but if considerable, they must be estimated and allowed for."

The saline ingredients are introduced into the water either by simple solution or by double decomposition. Chloride of sodium, sulphate of soda, and such salts, have merely to be dissolved; but when it is wished to obtain a bicarbonate of lime and chloride of sodium in solution, we are compelled to make chloride of calcium and carbonate of soda react on each other in the presence of free carbonic acid. The bicarbonate of magnesia is prepared in a similar manner; and by decomposing chloride of calcium by sulphate of soda, sulphate of lime is easily introduced into these waters.

With regard to those salts, of which mere traces are to be found in natural waters, such as the bicarbonates of strontia and manganese, the chloride of lithium, the borate of soda and some others, and also crenic and apocrenic acids, the authors consider that they play but a very secondary part, and may be altogether neglected without prejudice. They insert, however, arseniate of soda in the formula for Vichy water, because the amount of that salt in the natural water has been estimated with exactitude by M. Bouquet.

To obtain the natural bicarbonate of iron it is preferred to make use of the finest iron filings, instead of reduced iron. The iron is to be mixed with the salts, and then rubbed with water, which is to be supersaturated with carbonic acid gas. After some hours the iron will be found to be entirely dissolved, and the solution will keep a long time without depositing oxide of iron. Silica the authors are disposed in general to disregard; but in some it is introduced in the form of silicate of soda. As regards carbonic acid, they remark that the amount in artificial must always be in excess of that in the natural water, inasmuch as this excess is indispensable for the preparation and preservation of the artificial compound.

Seltzer Water.

The formula for this water is calculated from the analysis of M. O. Henry, which we need not quote. In imitating this water all the substances of which mere traces are to be found are omitted; but it is stated that the formula subjoined gives a clear water, having a taste very like the natural Seltzer water:—

	Grammes.
Chloride of calcium (fused)	0·858
,, magnesium (crystallised)	0·088
,, sodium	1·389
Carbonate of soda	2·580
Iron filings	0·010
Carbonic acid	Five volumes.
Water	One litre.

The chlorides of sodium, calcium, and magnesium, are mixed with a small quantity of water, and then placed in the apparatus; the carbonate of soda and iron filings are then added, and the liquid is supersaturated with carbonic acid.

Our readers will see that this method will answer extremely well for the preparation of artificial mineral waters in gazogenes; and its adaptation to the manufacture of these waters on the large scale will require but little contrivance on the part of the manufacturer.

(To be continued.)

PHYSICAL SCIENCE.

On the Spectrum of the Electric Spark in Compound Gases, and particularly in Fluoride of Silicium, by M. J. M. SEGUIN.

WHEN the spark traverses fluoride of silicium in a tube inversed over mercury it produces a very beautiful blue

light. This colour shows in the spectrum as a large, bright blue ray, far removed from the green.

Fluoride of boron, containing, it is true, some traces of fluoride of silicium, gives the same effects, and a similar blue ray.

It seems admissible to attribute this distinct blue ray of the spectrum to fluorine, as M. Plücker does not mention it among those he has observed in the rarefied vapour of chloride of silicium. The rays seen by M. Plücker were one red, one orange, three green, and one blue; three proceeding from chlorine, the others, probably, from silicium. In the saturated vapour of the same compound I have also observed two red or orange rays, three green and one blue, or rather violet, the blue being very brilliant, but lighter than that of fluoride of silicium, and very near the green.

Enclosed alone in a narrow tube, and submitted to the influence of a series of sparks some millimetres long, between two platinum wires, fluoride of silicium, after more than an hour, is not sensibly decomposed. In the first few moments some vapour and a white deposit are formed, arising, probably, from the remains of humidity, but they do not increase. After the first period the volume of gas remains invariable. Decomposition and successive combinations, no doubt, take place.

Mixed with hydrogen, fluoride of silicium decomposes rapidly. The latter gas being in excess, the hydrogen rays gradually fade. Under a platinum crucible, serving as a receiver, the reaction absorbs twice as much hydrogen as fluoride, and the sides of the crucible are covered with a dark grey coating. In glass tubes the reaction is complicated by the hydrofluoric acid attacking the glass. Two volumes of hydrogen generally disappear for one volume of fluoride, and against the tube a buff-coloured solid product is deposited in layers or flakes, which burns with a little explosion, and which, heated in the tube where it is formed, disengages hydrogen nearly to the amount of that which had disappeared over and above the two volumes. These properties, and some others, are not sufficient to prove the identity of this product; I trust that a more powerful induction apparatus will admit of my collecting a quantity sufficient for analysis.

The decomposition of fluoride of boron mixed with hydrogen produces liquid drops, with a light blackish deposit.

The appearance of the spark is generally an evidence of its chemical action. When it passes without occasioning any reaction, it is slight, and the rays of the spectrum are then very defined; and the rays are less distinct, and are enveloped in an aureola, when there is decomposition or combination. However, the distinctness is increased by multiplying the solutions of continuity in the discharge-conductors, while the voluminousness of the spark is increased by adding a weight to the hammer of the contact-breaker. The change from the thin spark to the voluminous form indicates that the reactions are at an end. In the decomposition of strongly-carburised gas, the spark resembles a flame, and, probably on account of the large number of fragments of incandescent carbon, the spectrum appears continuous to the naked eye, like that of the white part of an ordinary flame. When the gas is mostly decomposed, the hydrogen disengaged, and the carbon deposited on the electrodes, the spark is small, and hydrogen rays become visible in it, as well as other rays, belonging either to carbonised hydrogen or to the carbon itself. In interpreting many experiments, it would be advisable not to overlook these observations.—*Comptes Rendus.*

NOTICES OF BOOKS.

Report on the Results of Experiments to Ascertain the Consumption of Gas at the Public Lamps; and on the Application of the Carburating Process, &c., &c. By W. Haywood, Engineer; and H. Letheby, Medical Officer of Health to the City of London.

That some improvement in our public lighting was both possible and desirable, every one was convinced before the present alarm about garotting took possession of people's minds. It is some satisfaction to know that the fact has been recognised by those who have some power to remedy the grievance; and our readers may, at the present time, see two different attempts at improvement going on in various parts of the metropolis. In Sackville Street, Piccadilly, he will find the centre of each pane of the lamp which shows along the street, fitted with a bull's eye lens. The effect of this can be easily imagined. A strong glare of light is thrown into the passers' eyes, while the pavement is left in complete darkness. The experiment appears to us eminently unsatisfactory. In the City they have endeavoured to increase the illuminating power of the gas by what is called the "carburating process," that is, by passing the gas over naphtha contained in a vessel placed just under the burner. The value of this process is unquestionable, since it has been shown that ordinary gas, giving the light of twelve candles, may, by taking up from four to seven grains of the naphtha vapour per cubic foot, have its illuminating power increased twenty-five or thirty per cent. But the process applied to the City lamps has not given the satisfactory results which were expected. There have been several reasons for this. The vessels containing the naphtha are too large, and obstruct much of the light; the burners have, in many instances, been placed so high in the lamp, that the flame is on a level with the wide iron frame, which also cuts off a good deal of light. There are still other reasons why the results have not been so successful as was expected. The gas companies, as a matter of course, did all they could to prevent the success; and the carburating company did not do all they could to ensure it. Dr. Letheby examined eighteen samples of the liquids from the carburators with the following results:—

"1. That in one-sixth of the cases there was no naphtha whatever, but merely water, in the carburator; and

"2. That in no instance was the naphtha of the quality necessary to give the desired increase of illuminating power to the gas." The Doctor had "already ascertained that the naphtha should give, at least, 6·5 grains of volatile hydrocarbon to each cubic foot of gas to raise the illuminating power to the required standard of 30 per cent. above the ordinary quality." The City authorities are now about to take the matter into their own hands. They intend to place a meter at each street lamp, and supply the carburators themselves; and there cannot be a doubt that, if proper vigilance be exercised, the results will be a considerable saving to the rate-payers in the cost of gas, and a great increase in the illumination of the streets. But it will require great vigilance to prevent the gas companies from playing tricks such are more than hinted at in this Report.

Air and Water; their Impurities and Purification. By Henry Bolman Condy. London: Davies. 1862.

The terms *deodoriser* and *disinfectant* are sometimes, we might say, generally, used with most unscientific laxity. A substance which is merely a deodoriser is often called a disinfectant; and both words are often applied to bodies which are only antiseptics. It is true that there are some things which are at once both deodorisers and disinfectants, as is the case with the permanganates of potash and soda. These bodies, by easily parting with their oxygen, hurry

organic matter in a state of decomposition to the last stage of oxidation, so destroying the compounds which possess the repulsive odours evolved in the course of decomposition, and also, no doubt, burning up the effective agents in the production of some diseases. They have, too, the effect of decomposing any sulphuretted hydrogen or sulphide of ammonium which may have been produced in the decomposition of organic matter. Nor, so far as water is concerned, do the results end here. In the case of water which may have become contaminated with lead, Mr. Condy has shown that the permanganates have the power of converting the protoxide of lead which the water holds in solution into the insoluble peroxide, and so effectively removing every trace of the metal. As this, perhaps, will be to our readers the most novel application of Mr. Condy's solution, we shall quote his experiments in illustration of this reaction, which some may wish to repeat for themselves.

"By shaking common white lead in distilled water, I made a saturated solution of oxide of lead, which, on being tested with hydro-sulphuric acid, showed a black precipitate. I took four ounces of this solution, and added to it two drops of a solution consisting of two grains of permanganate of lime, dissolved in one ounce of distilled water. The mixture, I found, did not immediately lose the pink colour communicated by the permanganate. I let it stand half an hour, by which time all shade of pink had disappeared, and was replaced by a brown shade (that of binoxide of manganese), which proved that the expected reaction had occurred. I then filtered it. The filtrate was colourless, but, on being tested afresh with hydro-sulphuric acid, it again acquired a dark tint, much less, however, than in the first instance. This was a sign that lead was still present, though in a minor degree. I recommenced with the same quantity of the solution of oxide of lead, but this time added five drops of the solution of the permanganate of lime. To hasten the reaction I heated half an ounce of the pink solution in a test tube, and filtered. The filtrate showed not a trace of lead on the application of hydro-sulphuric acid. Without using heat, I allowed the remainder of the mixture to stand two hours. When then examined the colour was found entirely changed from pink to brown. A portion of this was tested as before, for lead; the result indicated its entire absence. The rest was set aside without being filtered until the following day; the binoxide of manganese formed by the action of the permanganic acid had entirely subsided, carrying with it the peroxide of lead, and leaving the water clear and free from trace of that metal. The following is the *rationale* of this reaction:—

$$CaOMn_2O_7 + 3PbO = 2(MnO_2) + 3PbO_2 + CaO.$$

Water can thus be readily and completely freed from lead, which is the most poisonous of all metallic contaminations, and, by reactions of a similar nature, from all metals capable of assuming the form of peroxides."

Mr. Condy proceeds to point out that these reactions show that alkaline permanganates may be used as antidotes in cases of poisoning by lead or copper.

We need not say more on the purification of water by means of the permanganates. The importance of an easy method of estimating soluble organic impurities, and the numerous instances in which the removal of these impurities is a matter of consequence in an industrial, as well as sanitary, point of view, will commend the use of these agents to numerous readers who have only to make one trial to satisfy themselves of their value.

The purification of air is not so easy a matter, but yet there is no doubt that this can, to some extent, be effected by agency of the permanganates. The atmosphere is full of organic impurities, most of them harmless, no doubt, but some offensive, and all objectionable. When these impurities are brought into contact with a permanganate, they are oxidised as rapidly and completely as those held in solution by water; and, by being drawn or forced through a solution of a permanganate, Dr. Angus Smith has shown that air is perfectly purified. But it is found that much of the atmospheric pollution may be got rid of by simply exposing the solution in shallow vessels; and any one wishing to ascertain the condition of the atmosphere in a particular apartment or locality, as regards these impurities, can easily do so by means of the following experiment:—

"Place in line four or a larger number of perfectly clean small dishes of white earthenware. Into each pour one ounce of distilled water. To the first, then add a single drop of a solution of permanganate, of definite strength, such as Condy's patent ozonised water; to the second, two drops; to the third, three drops; and so on to the last, according to the number of vessels used. Let the dishes so charged remain over night, or during any part of the day, exposed to the air in a quiet corner of the room where the experiment is to be made. On examining them in the morning, or after a lapse of time, it will be easy to judge comparatively of the condition in which the atmosphere has been maintained during the time of their exposure."

Of course, if No. 2 is completely decolorised, it will indicate twice the amount of impurity which would have been present if only No. 1 had been decolorised. The decoloration of No. 3 will indicate three times the quantity, and so on through the series, the decoloration of No. 4 showing that the air must be decidedly polluted. Such results, although, as Mr. Condy says, they may not be useful as scientific data for philosophical purposes, are yet sufficiently accurate for ordinary sanitary objects.

We shall not follow Mr. Condy into his speculations on the nature and constitution of morbid poisons, ingenious and interesting as they are, but recommend such of our readers as are curious in these matters to read the book for themselves. His views, however, of the action of the permanganates on organic effluvia deserve to be quoted:—

"Of the oxidable impurities which are found in the atmosphere, few are so disposed to combine with active oxygen as the decomposing effluvia which proceed from the morbid and putrefying bodies and the *effete* excreta of men and other animals. When in a condition for combination, their elements form with that substance compounds of a most permanent nature. Assuming those matters to resemble in constitution nitrogenised animal bodies, their behaviour in the presence of permanganate of potash may be represented by the following equation:—

$$HO_4C_7N_2 + 7(M_2O_7 + KO) = HO + 7CO_2 + 2NO_5 + 14MnO_2 + 7KO."$$

This book does the author much credit, and its publication, we hope, will greatly extend the use of the permanganates. Their value as purifiers of water can hardly be over-estimated. It will be a great day for chemistry when some one shows us how to produce active oxygen in a gaseous state in large quantity.

NOTICES OF PATENTS.

2298. *Batteries for obtaining Electric Currents, and the Products therefrom.* T. Morris, R. Weare, and E. H. C. Monckton, Trafalgar Square, London. Dated September 14, 1861.

This invention consists in an improved arrangement of battery cells, wherein certain metallic ores are employed to generate electrical action, and, at the same time, give rise to the production of valuable metallic salts, which may in turn serve as exciting fluid in batteries of the ordinary construction. A series of reservoirs are excavated in the earth, the inner walls are lined with glazed tiles, and, for porous diaphragms, wood is used, from which the greater portion of the resinous matter has been dissolved out, by means of caustic potash or soda. In order to

charge the battery, one side of the porous diaphragm is filled in with native oxide or other description of copper ore, coarsely powdered, and watered with a strong solution of common salt, and a carbon electrode is imbedded in the midst, to serve as a conductor, and form one pole of the battery. On the other side of the diaphragm dilute sulphuric acid is employed, likewise with a carbon electrode in communication with the same, and constituting the opposite terminal of the battery. Under these circumstances, the products formed in the battery during its action, will consist, on the one hand, of sulphate of soda, whilst chloride of copper will be left on the other side of the porous division, and throughout no gas will be evolved if the several ingredients be rightly proportioned. Many other ores and chemical agents may be employed in this manner to produce electrical action, and at the same time serve in the formation of valuable metallic compounds.

This proposal is very similar to that of M. Tolhausen, which, though of earlier date (August 26, 1861), was not proceeded with. The remarks made in reference to the principle of that suggestion * are equally applicable to the present case.

2312. *Improvements in Treating Stone, Bricks, and other Surfaces, and in the Manufacture of Filters.* F. M. and E. L. Ransome, Ipswich. Dated September 16, 1861.

For the purposes of this invention the patentees take sand, powdered flint, or stone, glass, or other hard or vitrefied material, and mix with the same a solution of any soluble silicate in such proportion as to form a paste or wash, which can be applied to the surface of brick or stone in the same way as stucco. Such coating is either allowed to dry partially, or is directly acted upon with the solution of any salt or earth, such as the chloride of calcium, which will by double decomposition produce an insoluble silicate, and form a kind of cement between the particles of sand or other pulverulent material employed. For the construction of filters, the patentees make their artificial stone in the form of hollow triangular pipes, by which they are enabled to obtain filtering surfaces of greater superficial area within a given space than can be accomplished by any other plan; such triangular tubes admit of being arranged in a great variety of ways to suit different purposes.

Messrs. Ransome's artificial stone has already been so frequently noticed in the pages of this Journal as to render any special remark in this place unnecessary.

2326. *Improvements in Apparatus for Freeing Gases from Dust and other Particles of Matter floating therein, and for causing Vapours or Gases to be absorbed by Liquids.* E. A. Cowper, Great George Street, Westminster. Dated September 18, 1861. (Not proceeded with.)

The apparatus described and claimed is one wherein the gas during its passage is caused to come into contact with porous substances saturated with water, in such a manner that a large extent of moist surface is presented, whereby the gas may be thoroughly cleansed from any particles of solid matter in suspension, or from vapours which may be dissolved and condensed by water.

The arrangement thus described is identical in principle and action with the ordinary coke "scrubber," used in gas-works; or when applied specially to the condensation of hydrochloric acid, or such like vapours, represents precisely the invention long since patented by Mr. Gossage, of Warrington.

2339. *An Improved Fuel.* E. Breffit, King William Street, London. Dated September 19, 1861.

This improved fuel consists of a small rough box of wood, made about the size of a common brick, and filled with coal. A wooden cover is fixed on the top of the box, so as completely to enclose the coal. Such boxes or fuel blocks, being perfectly clean, may be placed on the fire by hand, when they ignite more readily than coal itself.

Grants of Provisional Protection for Six Months.

2026. Oliver Perry Drake, Massachusetts, U.S., "A new and useful or improved apparatus for vaporising and aërating a liquid hydrocarbon to be burned for illumination, or for other purposes."—Petition recorded July 14, 1862.

2853. Alexander Chaplin and George Russell, Glasgow, Lanarkshire, N.B., "Improvements in obtaining fresh water by evaporation, and in apparatus therefor."

2865. Louis Groux, Victoria Soap Works, Woodhouse Junction, near Sheffield, "Improvements in the manufacture of soap, and in machinery for that purpose."

2881. Enrico Angelo Ludovico Negretti, and Joseph Warren Zambra, Hatton Garden, London, "Improved apparatus for ascertaining or testing the explosibility of liquid hydrocarbons."—A communication from Guiseppe Tagliabue, New York, U.S.—Petitions recorded October 25, 1862.

2887. Frederick Lipscombe, Strand, London, "Improvements in purifying water."

2891. John James Ridge, Thomas Street, St. John's, Southwark, Surrey, "Improvements in treating certain farinaceous substances applicable to infants, or invalids' food, and in apparatus to be employed therein."

2895. Thomas Richardson, Newcastle-upon-Tyne, "Improvements in the manufacture of sulphate of soda."—Petitions recorded October 27, 1862.

2903. Edward Scripps Tudor, Upper Thames Street, London, "Improvements in the purification of lead."

2909. George Darlington, Minera, Denbighshire, "Improvements in the manufacture of zinc oxide."

2919. Daniel Fryer, Carlton Square, Old Kent Road, Surrey, and Joseph William Meears, Annett's Crescent, Islington, London, "Improvements in casks, tanks, or other receptacles for containing petroleum and other oils or spirits."

2937. William Renwick Bowditch, Wakefield, Yorkshire, "Improvements in carburetting or naphthalising gas, and in the apparatus employed therein."

2953. James John Anderson, St. James Street, Northampton, "A new or improved mode and means for the production of leather from waste leather scraps, and also for producing from such waste leather scraps, in combination with India-rubber, gutta-percha, or other like substance, a new material to be used as leather, and for other purposes."—Petitions recorded October 31, 1862.

Notices to Proceed.

2026. Oliver Perry Drake, Massachusetts, U.S., "A new and useful or improved apparatus for vaporising and aërating a liquid hydrocarbon to be burned for illumination or for other purposes."—Petitions recorded July 14, 1862.

2072. Thomas Davey, Tuckingmill, Cornwall, "Improvements in the manufacture of gunpowder and explosive compounds."

2107. William Henry Perkin, Seymour Villa, Sudbury, Middlesex, "Improvements in printing and dyeing when aniline and analogous coal tar dyes are employed, also in preparing colouring matters."—A communication from Alexandre Schultz, Rue St. Fiacre, Paris.

2112. James Anderson, Allan Bank, near Braco, Perthshire, N.B., "Improvements in separating gluten from starch, and in preparing gluten for food."

2136. Alfred Noble, Bristol, Gloucestershire, "Improvements in obtaining and treating compounds of alumina."

2206. William George Valentine, Oxford Street, London, and Frederick Levick, Blaina, Monmouthshire, "Improvements in the generation of combustible gases for lighting

* Chemical News, vol. vi. p. 214.

and heating purposes, and in the mode of applying such gases to the manufacture of iron, glass, and other processes in the arts where great heat is required."—Petition recorded August 6, 1862.

2458. Sidney Hopton Hadley, City Mills, Upper Thames Street, London, "An improved process for manufacturing gas for illumination."—Petition recorded September 5, 1862.

2837. Joseph Duke and John Cleaver, Puriton, Somersetshire, "Improvements in the manufacture of cement."—Petitions recorded October 21, 1862.

CORRESPONDENCE.

Composition of Wheat, Barley, &c.

To the Editor of the Chemical News.

Sir,—In reference to the question of the presence of alum and alumina in flour and bread, I think the publishing of analyses of grain and ashes of grain may be of some use; I, therefore, send you, for insertion in your paper—

1st. The most recent analysis of grain, made in Utrecht, in Professor Mulder's laboratory, and according to methods devised by him.

2nd. A series of analyses of ashes, more especially of wheat, made by divers authors, and not always easily gathered together. This I do not claim as any merit of mine, for the whole of the analyses herewith forwarded I took from Mulder's work on "Beer," translated by me into English from the original Dutch, but which translation is as yet only in MS., though quite complete.

I am, &c.

Dr. A. Adriani, F.R.N.S.E. &c.

Edinburgh Laboratory.

Analysis of Barley, Wheat, Rye, and Oats, by Professor G. J. Mulder, Utrecht University.

	Barley.	Wheat.	Rye.	Oats.
Dextrine	4·5	4·5	5·2	5·0
Amylum (starch)	53·8	57·0	56·5	47·0
Sugar	0·0	0·0	0·0	0·0
Cellular tissue	7·7	6·1	7·8	14·5
Albuminous compounds	9·7	11·5	10·4	12·1
Fat	2·1	1·8	1·4	5·4
Mineral or incombustible matter	2·1	1·7	1·8	2·8
Water	18·1	16·0	16·4	14·9
Alcoholic extract*	0·7	0·8	1·2	0·6
Aqueous extract*	7·0	6·8	8·2	7·9

Analysis of the Ashes (incombustible matter) of Wheat, by Messrs. Weber, Baer, Way and Ogston, and Herapath.

	Weber.	Baer.	Way and Ogston.			Herapath.
			Hopeton Wheat.	Creeping Wheat.	Red Wheat.	
Potassa	23	27	33	31	28	35
Soda	3	—	—	—	0·6	3
Chloride of potassium	—	1	—	—	—	—
Chloride of sodium	10	—	—	—	—	—
Lime	3	4	3	2	3	2
Magnesia	12	13	13	12	14	9
Oxide of iron	1	1	0·6	0·2	0·2	—
Phosphoric acid	46	46	47	46	50	50
Sulphuric acid	—	—	0·2	0·6	0·6	—
Silica	1	8	3	2	2	—

* These estimations were made with reference to the elucidation of the principles of the process of brewing beer.

Per cent. of Ashes.

Weber found in dry (air dried) wheat	1·28
Way and Ogston found in dry Hopeton wheat	2·0
" " " creeping wheat	2·0
" " " red wheat	2·0
Herapath found in wheat	2·3

Weber alone found so large a quantity of chloride of sodium.

According to Messrs. Will and Fresenius, Bichon, Thon, Petzholdt, Boussingault, and Erdmann, the composition of the ashes of wheat is as follows:—

	Will and Fresenius.		Bichon.	Thon.	Petzholdt.	Boussingault.	Erdmann.
	Red Wheat.	White Wheat.				Wheat from Bechelbronn.	
Potassa	21·9	33·8	6·4	24·2	25·8	30·1	25·9
Soda	15·8	—	27·8	10·3	2·7	—	0·4
Lime	1·9	3·1	3·9	3 0	1·5	3·0	1·9
Magnesia	9·6	13·5	13·0	13·6	12·2	16·3	6·3
Oxide of iron	1·4	0·3	0·5	0·5	0·2	—	1·3
Phosphoric acid	49·3	49·2	46·1	45·5	57·3	48·3	60·4
Sulphuric acid	0·2	—	0·3	—	0·4	1·0	—
Silica	—	—	0·4	1·9	0·3	1·3	3·4

The estimations of the alkalies in the analyses of Bichon and Thon are not to be considered as correct.

Composition of the Ashes of Barley, by (I.) *M. Veltman and* (II.) *M. Moesman, Chemical Laboratory, Utrecht University. Barley yields from 2·4 to 2·6 per cent. of ashes.*

	I.	II.
Potassa	17·0	17·5
Soda	5·9	6·3
Lime	2·7	3·1
Magnesia	7·2	6·8
Sesquioxide of iron	0·5	0·5
Phosphoric acid	30·3	—†
Sulphuric acid	1·4	1·5
Insoluble silica	7·1	7·0
Soluble silica	26·0 (33·1)	26·7 (33·7)
Chlorine	1·3	1·3

Results of Analyses by Dr. Oudemans, First Assistant to Professor Dr. G. J. Mulder, Utrecht University.

	Wheat.		Barley.	
	—	Quite Dry.	—	Quite Dry.
Starch	57·0	67·9	53 8	65·7
Dextrine	4·5	5·4	4·5	5·5
Glutine (a nitrogenous compound soluble in alcohol, insoluble in water)	0·42	0·5	0·28	0·3
Coagulable albumen	0·26	0·3	0·28	0·3
Two peculiar albuminous compounds soluble in water, not coagulable	1·55	1·9	1·55	1·9
Insoluble albumen	9·27	11·0	7·59	9·3
Fat	1·8	2·1	2·1	2·5
Cellular tissue	6·1	7·2	7·7	9·4
Incombustible matter	1·7	2·0	2·5	3·1
Water	16·0	—	18·1	—
Extract producing and other substances	1·4	1·7	1·6	2·0

The precise localities where the grains were grown could not be ascertained. In Belgium, wheat is largely used for

† Estimation lost, by accident

brewing purposes, both malted and raw. The whole of the albuminous compounds of grain, but more especially glutine and the two peculiar albuminous compounds, play a very important part in the divers processes of malting, and in the brewing operations.

Webster's Process for Making Oxygen.

To the Editor of the Chemical News.

Sir,—In your Journal of November 29, Mr. Dugald Campbell doscribes an investigation he has made on heating nitrate of soda and oxide of zinc together for the purpose of making oxygen, the results of which, I must confess, I do not understand.

20 lbs. of oxide of zinc are taken, and at three different times heated with 10 lbs. nitrate of soda, making, in all, 50 lbs. of material, namely, 20 lbs. oxide of zinc, and 30 lbs. nitrate of soda.

Mr. Campbell says the results of heating are 37 lbs. left in the retort, and 158 cubic feet of gas in the gasholder.

The residue in the retort consisted of—

Sand, with oxide of iron ! ! ! . .	=	13·66
Oxide of zinc	=	30·20
Anhydrous soda	=	24·80
Nitrite of soda, with a little nitrate .	=	31·34

in 100 parts.

Reducing these proportions to 37 lbs., the quantity left in the retort, we get—

Sand, oxide of iron, and oxide of zinc	=	16·2
Anhydrous soda	=	9·2
Nitrite of soda, with a little nitrate .	=	11·6
Parts or lbs. . . .		37·0

Now, it will be found that the equivalents are of—

9·2 anhydrous soda = 24·7 nitrate of soda, and of
11·6 nitrite of soda = 12·7 ,,

making altogether . = 37·4 nitrate of soda from 30 to begin with.

This is a curious result, but nothing to what Mr. Campbell goes on to describe.

The residue of the retort is now put into the condenser, which he explains in your Journal, and the gas from a new charge of the retort is passed through it, by which the anhydrous soda and nitrite are converted into nitrate of soda, besides making 158 cubic feet of gas in the gasholder.

What has this gas come from?

He tells us it is oxygen and nitrogen; but how can it be so when the nitrate of soda is nearly all recovered in the condenser?

Perhaps some of your readers, or Mr. Campbell himself, may enlighten me. I am, &c.

An Inquirer.

Black Dye from Aniline.

To the Editor of the Chemical News.

Sir,—There have been many colours produced from "aniline" and its analogues, namely, violets, pinks, blues, &c., but I have not seen or heard of a good black that has been produced from aniline, capable of being printed or dyed along with the above-named colours, excepting one that was discovered by me about two years ago; and I now take the opportunity of enclosing you swatches of my new black from aniline (dyed and printed) for your inspection and trial.

This black has peculiar properties, being perfectly fast, and not affected either by light, or being boiled for several hours in a strong solution of soap. Strong sulphuric acid destroys the cotton, but leaves a black or purple pigment behind. Strong caustic soda does not injure the colour, even if boiled, and the strongest solution of hypochlorite of lime does not affect it in the least; in fact, all the chemical agents I have tried will not discharge it. It is a valuable black for Turkey-red styles; and when printed along with madder colours it fixes "perfectly fast," and does not take the dye from the madder-bath; hence its value as a substitute for chemical black. It is also valuable as an "indelible ink," and for marking grey goods, as a substitute for "tar."

If you will kindly insert this in your next journal, perhaps some of your numerous correspondents will suggest some other use for this "indestructible black." I simply bring this before your notice, lest it should be claimed by some other colorist or chemist at some future time. I am, &c. John Lightfoot.

Broad Oak Laboratory, Accrington, Lancashire.

[The colour is not a pure black, and does not look so well in the solid as in the printed specimens, which show extremely well. Chlorine will almost discharge the colour.—Ed. *C. N.*]

"Miller's Chemistry."

To the Editor of the Chemical News.

Sir,—Your correspondent, "Teuto," will find the error in the formula, given at p. 199 of the 1st Part of my "Elements of Chemistry," second edition, pointed out in a table of *errata* at the close of Part 3.

I am, &c.

Wm. Allen Miller.

King's College, London, December 2.

Preservation of Stone.

To the Editor of the Chemical News.

Sir,—The solution for stone hardening, to which we beg to call your attention, is composed of lime, silica, and alumina, with soda, there being a very small proportion of the latter article. We can make the solution strong or weak as occasion requires, and, in either case, some few hours after its use, it sets and becomes a solid, and time will make it as hard as flint. There is nothing more easy than its application; and, as you see by the following specimen of stone herewith, the pores thereof are not only filled up, but the surface of the stone is polished.

The simplicity of our plan for hardening and preserving stone will, we think, insure its adoption. It is of such a little cost, and any one can apply it. There is no chemical action, no decomposition and double ditto to be effected within the stone—nothing but a filling-up of the pores of the stone with a substance—a cement or concrete—not liable to change by the action of the acids in the atmosphere, but one that will only harden by time. The principal novelty of our plan consisting in the fact of there being nothing to wash out of the stone, you will particularly observe this fact, in proof of which we point to the polished surface.

Then with regard to our artificial stone, which is made by mixing the same solution with sand, etc., we can only point to the sample herewith; and although this can be made and used anywhere within a few hours, at a cost not much exceeding that of bricks, this would be better than it is by bringing mechanical pressure to bear upon it in the mould, which power we do not possess.

In the limits of this letter we cannot even hint at the many uses this solution may brought to.

We are, &c. Jesse Rust & Co.

Lambeth Glass Works, Carlisle-street.

[The stones submitted have certainly a beautiful appearance, but the process as described bears a great resemblance to one already patented.—Ed. *C. N.*]

Simpson and Others v. Wilson and Another.—In consequence of the great interest excited by this important trial, we have made arrangements for giving, in the Chemical News, a report of the whole of the chemical evidence brought forward.

MISCELLANEOUS.

STATISTICS OF THE ALKALI TRADE OF THE UNITED KINGDOM, 1862.

Annual value of finished products, 2,500,000*l.*
Weight of dry products, 280,000 tons.

Raw Materials consumed per annum.

	Tons.
Salt	254,600
Coals	961,000
Limestone and chalk	280,500
Pyrites	264,000
Nitrate of soda	8,300
Manganese	33,000
Timber for casks	33,000
Total	1,834,400

Capital employed in the Manufacture.

In land	£235,000
In plant, buildings, &c.	950,000
Working capital	825,000
Total capital	£2,010,000

Annual Cost of Materials for Repairs.

Stone, bricks, slates, iron, lead, timber, &c. £135,500

Labour, not including Labour in Transit.

	Number of Hands.	Souls.	Annual Amount of Wages.
Directly employed	10,600	53,000	549,500
Employed in getting coals	3,100	15,500	112,840
,, making salt	420	2,100	16,380
Getting and breaking limestone	660	3,300	25,740
Getting pyrites	4,030	20,150	157,150
Felling and sawing timber for casks	330	1,650	10,140
Total labour employed in the manufacture, and in the preparation of raw materials used in it	19,140	95,700	871,750

Weight of Raw Materials and of Finished Products Transported.

	Tons per annum.
By inland navigation	481,350
By railway	1,154,300
By coasting vessels	722,300
By foreign-going vessels	182,800
Total	2,540,750

Mem.—About one-fourth of the raw materials and finished products are transhipped in transit.

Weights of Waste Products.

	Tons per annum.
Alkali waste, burnt ores, cinders, slag, *débris*, &c.	1,273,000
(Of this quantity, about one-third, say 450,000 tons, is transported by railways and canals; the remainder is deposited in close proximity to the various works.)	
Waste acid, muriate of manganese, lime, &c.	2,600,000
Total waste products	3,873,000

Manufactures depending upon the Products of the Alkali Trade.

Soap.	Woollen.
Glass.	Colour making.
Paper.	All chemical manufactures of any magnitude.
Cotton, all.	
Linen.	

Linamentum Belladonnæ. Pharm. Brit.—The following is the formula for this now celebrated preparation:—Belladonna-root in powder, 16 ounces; alcohol, sufficient to make 16 ounces of concentrated tincture; to each pint of which 1 ounce of camphor is to be added.

Royal Institution of Great Britain.—At the General Monthly Meeting, on Monday, December 1, 1862, William Pole, Esq., M.A., F.R.S., Treasurer and Vice-President, in the chair; George Berkely, Esq., Michael Smith, Esq., John Ware Stephenson, Esq., and Major Henry Strachey, were elected members of the Royal Institution. Sir Roderick I. Murchison, D.C.L., F.R.S., was elected a manager, in the room of Sir B. C. Brodie, Bart., deceased. The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

Methylated Spirit.—From every side we receive complaints of the increasing use of this abominable compound. We scarcely need remind our readers that, in order to meet the complaint, that the high price of alcohol put difficulties into the way of English tradesmen by hindering them from using it in various manufacturing processes, the legislature, in 1857, allowed alcohol to be sold for manufacturing purposes (but not as a beverage) at a very low rate of duty, provided it were mixed with various nauseous empyreumatic oils, which, it was presumed, would render it unusable as a beverage. Thus, the chemist need not forego his experiments through the expense of spirit for his lamp; and the makers of varnish, of anatomical preparations, and the like, would be able to use alcohol cheaply, whilst alcohol used as a beverage would continue, as before, to be subject to a heavy duty. Fraud and avarice, however, have not been able to resist temptation. Some persons have set to work to *clean* the methylated alcohol, *i.e.*, to deprive it of its nauseous qualities, so that it may be sold and used as alcohol that has paid the duty—a thing equivalent to smuggling; whilst others have used methylated spirit, after more or less purification, for the preparation of medicinal tinctures. It may seem a very mean and odious thing to use, as medicine for the sick, a substance which has been purposely made too nauseous to be swallowed by the healthy; but the cheap cutting wholesale druggists think that they must live, and the public are notoriously pennywise. One well-known contributor writes:—"The druggists are poisoning our patients by filthy tinctures and spirits. I prescribed Spt. ammon. aromat. in a draught for a patient who was vomiting. She was made ten times worse by the filthy stuff sent, made of methylated spirit. They charge 1s. 6d. or 2s. for a mixture, costing 1d. or 2d., and even then will not keep to the Pharmacopœia."—*Medical Times and Gazette.*

ANSWERS TO CORRESPONDENTS.

E. F.—Gold size is the best thing to fix paper labels on tin vessels.

Received—G. F.; B. W.; G. Crace; and R. B.

Inquirer.—The Report on Class 2, Section A, we are told, will not be ready until the beginning of next year.

Atom.—Laurent's "Chemical Method," translated by Dr. Odling, and published by the Cavendish Society.

S.—Stearine is said to be readily bleached by means of oxalic acid. We never made the experiment.

Bd.—The aldehyde test is the best for alcohol, but you must be careful that no acetic acid is present in the distillate. If it be acid, neutralise with carbonate of soda, before adding the crystals of chromic acid.

THE CHEMICAL NEWS.

VOL. VI. No. 158.—December 13, 1862.

SECRETS FROM THE BRITISH PHARMACOPŒIA.

MR. SQUIRE and Mr. Hills—for the suppression of names after the last Pharmaceutical meeting would be an affectation—are fairly entitled to the full value of their several explanations. Mr. Squire, indeed, succeeded in completely exonerating himself from all blame in the matter. He explained very clearly that he had never sold anything but a belladonna liniment of his own invention, and that this had been sold but in one instance as the Pharmacopœia liniment under a misconception, and by an assistant, entirely without his knowledge.

The way in which Mr. Hills became possessed of the correct formula is also clearly stated. A prescription, in which the liniment was ordered, came to his shop, so he sent to the prescriber for the formula, and got it. The whole blame, therefore, is thrown on the prescriber, for whom a medical contemporary makes the same defence, that the prescription was written in that particular manner either through inadvertence or from idleness.

So far, all is well; the excuse may be taken for what it is worth. But we should like to be assured that this is the only "inadvertence" of the kind which has happened, and that no other new preparations from the Pharmacopœia have been prescribed under similar circumstances. It is the only case which has been made public, but how can we tell that no other formulæ have been obtained from the same source in the same way?

Mr. Vizer deserves the thanks of all pharmaceutists for the course which he adopted in bringing the matter before the Pharmaceutical Society. It was a matter which eminently deserved investigation by the Society, and the President will see how much he gained by having the opportunity of making a public explanation. It is to be regretted that any personal animosities should be engendered by the discussion; but every one will see that transactions of this kind must stir up passions which no fair competition in trade would excite.

In dismissing this affair, we can only recommend all pharmaceutists to do, under similar circumstances, exactly what Mr. Hills did in this case. If a prescription, in which is a preparation of whose composition they are ignorant, be brought to their establishment, they should send direct to the prescriber for the formula. If he give it, well and good; if he refuse it, they should make the matter public.

And now we would only ask,—What can be the motive for all this secrecy about the new preparations to be introduced into the Pharmacopœia? There are to be many, we are given to understand. We will hope that they may turn out to be valuable remedies—such things are wanted. Our own columns, those of the medical periodicals, and of the *Pharmaceutical Journal*, are all open to make them widely known; and thousands of sick people are waiting to be relieved. Must all wait because the Medical Council is in want of money, and is anxious about a copyright? The compilation of the Pharmacopœia has, indeed, been a prodigious expense to the Council, and no doubt the book will be thought dear when it appears. But we will not anticipate criticism, which is sure to follow the publication. We only repeat once more—let the Pharmacopœia be published at once.

TECHNICAL CHEMISTRY.

On Petroleum Gas.

NUMEROUS uses for the different light and heavy oils, which can be procured from petroleum by distillation, are already known, and application is now made of this curious product in a great number of forms. But it is as an illuminator that it will find most favour with the public, where the supply is constant and cheap; and it is very probable that, as an economical source of gas for illuminating and heating purposes, it will rapidly come into general use.

The results of a series of experiments which have recently been made at the gas works from which the small towns of Homer and Courtland, in the State of New York, are supplied, are most satisfactory and encouraging, both with regard to the luminous qualities and the remarkable cheapness of petroleum gas.

The following details are the results of careful measurement in all particulars, from which information as to the economy of the manufacture of petroleum gas could be derived.

The process employed at Homer and Courtland is similar, in most respects, to that which enables the proprietor of the Stevenson House, St. Catharine's, C.W., to light his establishment with 180 burners, at a cost of 86 cents a night, under what is known as Thomson's patent.

The retorts at Homer are two in number, and of the following dimensions:—

Length	7½ feet.
Breadth	16 inches.
Height	12 ,,

Two vertical tubes are cast on each retort for the purpose of supplying water and petroleum. The retorts are laid horizontally in an arch, exactly the same as ordinary coal gas retorts, for which they can be substituted without much trouble or expense. Each retort is divided into three chambers, called the petroleum, the water, and the coke chambers respectively.

Petroleum and water are introduced in continuous streams through the tubes before described, so that, when once a barrel of petroleum is placed at a sufficient height to allow a pipe provided with a stop-cock to feed the retort, the fluid may be admitted, and the process of conversion into gas goes on without further trouble, until the barrel is exhausted.

Two series of experiments were recently made at Homer, with the following results :—

Mean of the Two Experiments.

Total quantity of gas made, 5280 cubic feet.
Total time occupied in making the gas, five hours thirty-five minutes, or very nearly 1000 feet per hour, or 500 feet for each retort.
Petroleum consumed, eleven gallons per 1000 feet.

In the first hour of the second experiment, the quantity made was 1080 cubic feet; and the condenser showed that too much water was admitted (about one-eighth of the whole quantity of petroleum). This unnecessary quantity of water evidently cooled the retort, and prevented the gas from being formed so rapidly as during the first trial.

A one-foot burner, with this gas, gives as brilliant a light as a four-feet burner supplied with common coal gas.* Hence, 1000 feet of petroleum gas will go as far as 4000 feet of ordinary coal gas for illuminating purposes.

Now, when we examine these results, and compare them with what has been done in the manufacture of coal gas, the following remarkable comparisons present themselves.

In making coal gas, a charge of 150 lbs. of coal is generally introduced into the retort, and allowed to remain for five hours. It generates 600 feet of gas, if the coal is of moderately good quality. This is at the rate of 8000 feet for 2000 lbs., or one ton of coal. To produce 600 feet of gas, the destructive distillation has to be carried on for a period of five hours. In a retort of the same dimensions, and heated in the same manner, no less than 2500 cubic feet of petroleum gas are produced, under precisely similar conditions. But one cubic foot of petroleum gas is equal in illuminating power to four cubic feet of coal gas. Hence, in five hours the petroleum produces, when reduced to the equivalent of coal gas, the enormous quantity of 10,000 cubic feet of gas, against 600 by the coal process. The saving of fuel and labour is, consequently, enormous.

If we assume that the illuminating power of petroleum gas is only three times that of coal gas, the proportion of each kind produced in five hours is as follows :—

7500 cubic feet of gas by the petroleum process.
600 ,, ,, by the coal process.

Hence, in this case, which is below the actual results, the gain in time required for the manufacture of petroleum gas, as compared with coal gas, is as twelve to one. This fact alone reduces the number of retorts in petroleum gas works on a large scale, to at least, say, one-sixth of the number required for coal gas works. Actually, one petroleum retort can produce the equivalent in gas of twelve coal gas retorts. When the annual expense of retorts is taken into consideration, this item alone establishes a great argument in favour of the petroleum process; for not only is the number of retorts required diminished to the extent named, but all connecting pipes, huge hydraulic mains, and the extensive system of coolers and purifiers, are dispensed with in equal proportion. The labour of handling the coal is done away with, and a large proportion of capital in the construction of works saved.

To proceed now to the question of cost; assuming that two benches, each containing two retorts, are used for making petroleum and coal gas respectively. The cost of apparatus in the first instance is about the same. The time for heating and the fuel consumed is the same. The cost of eleven gallons of petroleum (or 1000 feet of petroleum gas), at 6 cents a gallon (the price in Toronto), is 66 cents. The cost of 250 lbs. of coal (or 1000 feet of coal gas), at $5 a ton, is 62½ cents. But 1000 feet of petroleum gas is, at the lowest estimate, equal to 3000 feet of coal gas. Hence, the cost of 3000 feet of coal gas (equal to 1000 feet of petroleum gas), or 750 lbs. of coal, at $5 a ton, is $1 87½. Then there is the coke to be deducted from the price of the coal used in making 3000 feet of gas, which may fairly be set against the smaller amount of labour required in handling the petroleum, when compared with the handling of the coal.

Where petroleum is 10 cents a gallon, and coal $6 a ton, the proportionate cost of the raw materials used will be as follows :—

Cost of 1000 feet of petroleum gas . .	$1 10
" 3000 feet of coal gas . . .	2 25

The foregoing comparisons refer to the original cost of the material from which the gases are made; but, if we take the price actually charged by gas companies into consideration, the results are the more striking.

The cost of private works to supply 200 burners will be about $1000; the labour of one man per diem; lime for purifying; three bushels of coke, at 10 cents a bushel; so that the entire cost will be—

Interest on capital, at 8 per cent. per annum	$80 00
Labour, at $1 per day	365 00
Lime for purifying, 200 bushels per annum, at 20 cents a bushel	40 00
Petroleum to produce gas for 200 one-foot burners, five hours a day throughout the year (365,000 feet of gas); 4015 gallons, at 6 cents a gallon	240 90
Fuel, say four bushels of coke a day, at 10 cents a bushel	146 00
Total cost .	$871 90

The equivalent of 365,000 cubic feet of petroleum gas in coal gas is 1,095,000, reckoning one foot of petroleum gas equal to three feet only of coal gas.

Cost of 1,095,000 cubic feet of coal gas, at $2 50 per 1000 feet (a low price in the United States and Canada) . .	$2737 50
Difference per annum in favour of petroleum gas	1865 60

If the price of petroleum is 10 cents a gallon, instead of 6 cents, the difference in favour of the gas will be, per annum, $1705. Thus :—

Interest on capital	$80 00
Labour	365 00
Lime	40 00
Petroleum	401 50
Coke	146 00
	$1032 50
1,095,000 cubic feet of coal gas, at $2 50 per 1000	2737 50
Difference in favour of petroleum gas, per annum	$1705 00

In works where twelve coal gas retorts are in operation day and night, each being charged with 150 lbs. of coal, they can produce 36,000 cubic feet of gas in twenty-four hours. This quantity can be yielded by two petroleum retorts in twelve hours. Thus :—

Two petroleum retorts yield 1000 cubic feet per hour.
In twelve hours the yield will be 12,000 feet.

* A recent writer in the American *Gas Light Journal* states that petroleum gas gives a light six or seven times as luminous as coal gas. This may be the case; but, in order to avoid an error in excess, we place it at four times as great as ordinary coal gas: that is to say, a one-foot burner with petroleum gas is equal to a four-feet burner fed with common coal gas.

The equivalent of 12,000 feet of petroleum gas is equal to 36,000 feet of coal gas.

If reduced to the same unit of time, namely, twenty-four hours, two petroleum retorts, of the same dimensions as coal gas retorts, will yield 24,000 cubic feet of petroleum gas, the equivalent of 72,000 feet of coal gas, or as much as twenty-four ordinary coal retorts charged with 150 lbs. of coal each, every five hours, can produce in twenty-four hours.

There are other facts which make the production of gas from petroleum more economical than from coal The quantity of lime required for purifying is not so great by one-half. The amount of water needed for cooling and washing is very considerably less, and the tar produced is small in quantity when the yield of gas is taken into account. The gas is more free from those noxious sulphurous compounds which render badly purified coal gas so disagreeable and prejudicial.

The destruction of retorts in the manufacture of coal gas is immense. This arises, in a great measure, from the formation of graphite in the inside of the retorts, which accumulates in concentric layers, and sometimes forms a coating one or two inches thick. The retorts also suffer to a great extent by the entrance of air when introducing the charge of coal. This source of rapid destruction is avoided altogether in the petroleum retorts, which do not communicate with the atmosphere when in a heated state, and only require to be occasionally opened to remove the deposited carbon or graphite, which, by the way, can very conveniently be removed by partially filling the petroleum chamber with fire brick, whereby the heated surface to which the rich hydrocarbon vapours are exposed is greatly increased, and their conversion into permanent illuminating gases much facilitated. The deposition of carbon is materially diminished by reducing the pressure of the gas on the retort, and this, by a simple adjustment of the water-joints in the petroleum apparatus, may be reduced to a minimum.

The use of water in the process by which the result described previously is produced, is for the purpose of converting the volatile hydrocarbon vapours of petroleum into permanent gases. It is thrown into its spheroidal condition the moment it strikes the interior of the retort, and in this state its spheroids continually develop steam of very high temperature and great reducing power. The rich petroleum gas may be largely diluted by the formation of the so-called water gas; but this has been shown to be an expensive process, and it is far more economical to employ a one-foot burner with a highly luminous gas than a three or four-feet burner with a diluted gas. The use of water gas as a diluant for rich hydrocarbon gases, which will burn without smoke or smell, and give a brilliant light from a small burner, is of not only very questionable economy, but it is thought by some to be a dangerous expedient, on account of the admixture of poisonous carbonic oxide into the gas, which, if leakage should by any accident occur in dwelling houses, might be followed by those fatal results to human life which have occurred time and again in every country where coal gas is manufactured, and particularly where water gas is used either with hydrocarbons or in any other form. Water gas, in order to be economical, implies the conversion of the carbonic acid produced into carbonic oxide, the one being a feeble illuminator, the other not only an incombustible, but so prejudicial to illumination that one per cent. of carbonic acid in coal gas diminishes its illuminating power by six per cent. The use of water gas has been interdicted by several European governments, on account of the poisonous properties of the carbonic oxide it contains. In the petroleum process, only so much water is used as will ensure the conversion of the volatile hydrocarbon vapours into permanent gases by their reduction to a lower hydrocarbon condition; and an analysis of its constituents shows that it contains much less carbonic acid than common coal gas. Its great illuminating power is derived from a very large per-centage of olefiant gas, together with carbonetted hydrogen.

Mr. G. Howitz, the manager of the Copenhagen gas-works, obtained 1000 feet of water gas by the combustion of 140 lbs. of coke in the furnace and about 20 lbs. of charcoal (15 lbs. pure carbon) in the retort. The water gas consisted of the following:—

Hydrogen	64
Carbonic oxide	18
Carbonic acid	18
	100

M. Gillard and M. Isard, in France, make water gas by passing superheated steam over coke or charcoal; but, by their process, 1000 cubic feet of mixed gases require 15 lbs. of pure carbon in the retort, and 118 lbs. of coke in the furnace.

1000 cubic feet of water gas can be obtained theoretically from 27·4 lbs. of water, although in practice much more is used, as a considerable portion of the steam is passed over undecomposed.

The following are the results of Mr. White's process, compared with that of M. Gillard:—

White's Process for the Manufacture of 1000 feet of Water Gas.

Coke in the furnace	112 lbs.
Charcoal in retort (equal to 15 lbs. carbon)	18 ,,
Lime for purifying	37 ,,

Gillard's Water Gas (Narboone).

Coke in the furnace	118 lbs.
Charcoal in the retort	18 ,,
Lime for purifying	67 ,,

The amount of fuel expended is not only very considerable, but the lime required for the abstraction of the carbonic acid is immense. When coal gas contains 5 per cent. of sulphuretted hydrogen and carbonic acid, it requires only 15 lbs. of lime to purify 1000 feet. But, by the foregoing table, White requires 37 lbs. and Gillard 67 lbs. of this material to abstract the carbonic acid from the same quantity of the water gas.

The advantages possessed by petroleum gas as a cheap illuminator have already been sufficiently established; but its claim to public patronage does not rest on this fact alone. It is a most economical and valuable source of heat. Coal gas stoves have long been in limited use, but they have not met with general favour, because they do not supply a sufficient amount of heat, and they are, besides, too costly when the coal gas is maintained at $2 50 per thousand feet. Petroleum gas is admirably adapted as a source of heat. It contains a much larger proportion of carbonetted hydrogen than coal gas; but carbonetted hydrogen generates more heat during combustion than either the same measure of hydrogen or carbonic oxide, as the following table, deduced from Dulong's experiments, proves:—One cubic foot of carbonetted hydrogen, during its combustion, causes a rise of temperature from 60° to 80° in a room containing 2500 cubic feet of air; whereas a cubic foot of carbonic oxide elevates the temperature of a room of 2500 cubic feet from 60° to 66°·6, and one cubic foot of hydrogen raises the temperature of a room of the same cubical capacity as before stated, from 60°

to 66°·4. Or, in other words, a cubic foot of carbonetted hydrogen is capable of heating 5 lbs. 14 oz. water from 32° to 212°, a cubic foot of carbonic oxide 1 lb. 14 oz. through the same degrees of temperature, and a cubic foot of hydrogen 1 lb. 13 oz. of water from 32° to 212°. With a burner and apparatus of peculiar construction, and consuming six feet per hour, a petroleum gas flame from eighteen inches to two feet in length can be produced under the same pressure as is used for lighting purposes. The flame is almost destitute of luminous qualities, but the heat it emits is intense. It can be used for heating private dwellings, for cooking, and other domestic purposes. The cost of this gas fuel is, at the rate of one stove burning for thirty days, ten hours a day, $1 30, when petroleum is 6c. a gallon; when it is 10c. the cost per month is $2. For $2 a month, the house of a poor man may be supplied with light and fuel during ten hours of the day. With a burner of less dimensions—say three feet per hour—a cooking stove and a one-foot burner, supplying abundance of warmth and light for one room during twenty-four hours each day, may be fed at a cost of $2 a month. This, of course, is the price of the raw material alone,

After a perusal of this article, every candid reader will acknowledge that gas from petroleum, manufactured by the process described, is not only the most economical had agreeable mode of illumination which has yet been brought before the public, but as a cheap source of heat it may present its claim to the patronage and encouragement of the public, with the best prospects of general adoption.—*Journal of the Board of Arts and Manufactures for Upper Canada.*

The Carburation of Gas.

The following is an outline of the specification drawn up by Dr. Letheby for the quality of the naphtha to be supplied to the carburators (nearly 2000 in number) of the City lamps. The particulars of the specification have been arrived at by a long series of experiments with naphthas of different densities and boiling points:

The naphtha must be colourless, and of a gravity not less than 830, nor greater than 860. When placed in a distillation apparatus in a bath of oil, and having a thermometer placed in the naphtha, it must begin to distil at a temperature not higher than 110° C. (230° F.), and must yield 70 per cent. of volatile naphtha at from 110° C. to 130° C. (266° F.), and 20 per cent. between 130° C. and 150° C. (302° F.). This is expected to leave but little residuum, and to give continuously 8 grains of hydrocarbon to each cubic foot of gas, and thus raise the illuminating power of the gas about 60 per cent. over that unnaphthalised.

On Nitronaphthaline, Naphthylamine, and its Coloured Derivatives, by M. Z. Roussin.

It is well known that the hydrocarbon called benzol by fixing the elements of hyponitric acid, forms nitrobenzol. United in this way as an acid molecule, nitrogen, by an intelligible reduction, may assume an alkaline character, and remain in the compound. The new base, aniline, is then obtained, the mobile elements of which adapt themselves readily to the phenomena of oxidation, or of substitution.

Naphthaline gives two parallel derivatives, nitronaphthaline and naphthylamine. It was interesting to ascertain whether this latter substance would equally produce the coloured derivatives analogous to those of aniline. A greater importance was given to this research, seeing the high degree of condensation of these substances, which naturally led me to expect greater stability in the compounds. I first gave my attention to producing these two substances easily and cheaply; first, nitronaphthaline, and then naphthylamine.

Preparation of Nitronaphthaline.—Into a globe of 8 litres capacity introduce 1 kilogramme of ordinary naphthaline, and 6 kilogrammes of commercial nitric acid, and dispose the apparatus over a bath of boiling water. The naphthaline first melts and floats on the surface. Shake the globe briskly from time to time. Some red vapours will be disengaged, and the oily layer will sink gradually to the bottom. The operation is then over. Hasten to decant the floating acid, and pour the oily matter into an earthen pan, where it will quickly congeal. At the moment of solidifying, constantly shake it, and wash it several times to carry off the excess of acid. To purify the nitronaphthaline it is sufficient to melt it, and to compress it strongly when cold. Melted nitronaphthaline can be filtered through paper, which it traverses as easily as water. Solid nitronaphthaline is of a reddish colour; but the powder has a beautiful yellow tint. Nitronaphthaline, which has been sufficiently compressed so as to free it from a red oil which impregnates the mass, is very pure. Almost the theoretical quantity is obtained. The acid mother-water of this preparation contains various products, and especially white binitronaphthaline, which often crystallises on cooling. The mother-waters retain a large quantity of nitric acid, coloured yellow, and capable of being utilised.

Preparation of Naphthylamine.—Introduce into a balloon six parts of commercial hydrochloric acid, one part of nitronaphthaline prepared by the above process, and to this add a quantity of granulated tin, so as to reach the top of the mixture. The balloon should not be more than half full. Place the apparatus in a water-bath, and shake it from time to time. In a few seconds an energetic reaction takes place; the nitronaphthaline disappears, and the liquid becomes limpid, though of a brown colour. Decant the liquid into a sandstone vessel, containing a mixture of two litres of commercial hydrochloric acid, and one litre of water, where the crystallisation of the hydrochlorate of naphthylamine soon solidifies the whole. When quite cold put it to drain on a coarse linen, and then forcibly compress it. To purify this salt it is sufficient to dry it thoroughly, to dissolve it in boiling water, to add sulphide of sodium to precipitate the tin, and to filter the liquid through wet paper, which retains a tar-like matter. The hydrochlorate of naphthaline crystallises by cooling. Strain, compress, and then heat it in a stove to + 100°.

Hydrochlorate of naphthylamine easily sublimes like benzoic acid or sal ammoniac. It is then very light, and in brilliant white flakes of great purity.

The mother-water of the last crystallisation of hydrochlorate of naphthylamine will serve for the preparation of naphthylamine itself, or it may be otherwise utilised.

The preparation of these various products by these processes is so simple, that one day only is required to obtain several kilogrammes of hydrochlorate of napthylamine, beginning with the naphthaline itself.

Among various trials I have made of naphthylamine for dyeing purposes, the two following will give the best idea of the important part which these products may be made to play:—

Mix two limpid and colourless solutions, one of hydrochlorate of naphthylamine, the other of nitrite of potash,

and a beautiful red precipitate is produced, insoluble in water. The application of this reaction to dyeing purposes is extremely simple. It is only necessary to plunge the specimens of silk or wool into a solution of hydrochlorate of naphthylamine, heated to + 50°, to wring them out, to get rid of the excess of liquid, and to plunge them into a cold and weak solution of nitrite of potash. Then wash them in plenty of water, and put them into alkaline water. According to the concentration of the liquids and their degree of acidity the shades of colour obtainable vary from a rose-colour to a deep-red chesnut. The chief characteristic of this colouring matter is its fixity. It is unalterable by exposure to light, unattackable by decolorising chlorides, sulphurous acid, alkaline solutions, and acid liquids. The strong concentrated acids turn this colour to violet, whilst the stuff itself remains impregnated with acid. The tint is restored in all its integrity, by simply washing in water. This colour, by its exceptional stability, reminds us of alizarine. It is sure to be quickly appreciated by dyers.

When rough hydrochlorate of naphthylamine, which contains perchloride of tin, is heated in an oil bath to about + 230° to + 250°, there remains in the retort, besides a large proportion of sublimed organic salt, a brilliant blackish mass.

This matter should be finely powdered, and treated several times with boiling water, to take away all soluble portions. After drying, treat it with boiling alcohol, which almost completely dissolves it, meanwhile developing an intense red-violet colour. When applied to stuffs this colour is unaffected by the sun, acids, or alkalies. I hasten to make these results public, and intend to continue my investigations.—*Comptes Rendus.*

On Alkali Waste, by Henry Deacon.

In the Number of the Chemical News for November 29 last, Mr. W. Gossage renewed his claim to be considered the originator of the theory, that the sulphur exists in this body as an insoluble monosulphide of calcium, and the excess of lime as caustic lime. Not only did Mr. Gossage publish this view, as he states, in 1838, but constantly and consistently since, as many others as well as I can testify, he has advocated the same views. It is not a little remarkable that, whatever other objections there are to be urged against this theory, the chief has usually, if not invariably been, the alleged solubility of sulphide of calcium prepared in the dry way. Fourcroy, however, pointed out that soluble calcareous liver of sulphur (soluble sulphide [polysulphide?] of calcium) "can be well prepared only by the humid way."—(*Vide* "Elliot's Translation of Fourcroy's Lectures." Edinburgh, 1785, vol. i., p. 337.)

Possibly these facts were known even earlier, but certainly to Mr. Gossage belongs the merit of first applying them to this question.

There are two points connected with this subject which, I think, would bear further elucidation. Mr. Gossage just glances at one of them—the action of a limited access of air on sulphide of calcium—I may say on many sulphides. The number of compounds thus formed, and the variety of their properties, deserve, and, I think, would well reward, the labours of a competent inquirer. The only fact bearing on this subject, on which I can speak with confidence after a rather lengthy experience, and which hitherto does not appear to have been generally noticed, is, that the presence of any body possessing alkaline properties, other conditions being constant, retards (but does not prevent) the oxidation of these compounds, and especially retards the formation of soluble sulphur compounds by the oxidation of insoluble sulphur compounds. This power is certainly more marked in, if not quite confined to, cases in which the protective body is either fused or in solution, and it is strongest with caustic alkalies, and the most concentrated solutions. I do not possess sufficient data to enable me to form a theory as to the cause of this. The preservation of sulphide of aluminium formed in the wet way by the method of Mr. C. W. Vincent appears to depend on this power of alkaline solutions. Under an alkaline solution this sulphide is preserved, but is oxidised immediately it is exposed to the air without the protection. The preservation of metallic iron from rusting by the agency of alkalies or their solutions is also well known, and is an analogous case.

The other point is the use of the surplus quantity of lime. From the facts just enumerated, I conceive it is to prevent the oxidation of the sulphide of calcium, or, in other words, to keep it in the insoluble condition; this result being effected, either by the direct action of the caustic lime, or, indirectly, by its producing its equivalent of caustic soda by causticising a portion of the carbonate of soda present in the black ash liquors.

Woodend Chemical Works, Widnes Dock, near Warrington.

PHARMACY, TOXICOLOGY, &c.

On Cane Sugar in its Relations to Simple and other Syrups, by Wilson H. Pile, *Jr.*

Every one who has been accustomed to prepare the various syrups and saccharine fluid extracts demanded in pharmacy must be aware of the uncertainty, and often perplexity, which attends their manufacture. The difficulty arises in part from a faulty manipulation, in the boiling being too long continued, or from a badly-shaped vessel, occasioning too great a loss by evaporation, before even the boiling-point be reached. In other cases, a want of proper adjustment of the liquid menstrua to the amount of sugar employed, giving a preparation either too thin or dense, or rendering it difficult or impossible to make the exact quantity required by the formula. In the non-medicinal syrups, a skilful operator can judge with sufficient accuracy, by various familiar signs, when the proper degree of consistency is arrived at; but this could not be done by an inexperienced hand, and, with the more important fluid preparations, where sugar is employed, a more exact and certain method must be used.

In our Pharmacopœia, it has unfortunately happened that in many of the formulæ the difficulties above alluded to are encountered, and the resulting syrup is either disposed to fermentation or to deposit sugar by crystallisation; while in other formulæ the quantity of the preparations, when finished, are greater than that intended, and, in consequence, its medicinal activity proportionally diminished.

The design of the writer of this paper is not to go into any consideration of the changes which sugar may undergo in the various syrups by long boiling, or from chemical changes occasioned by contact with substances with which it may be combined, but to offer some remarks of a more practical character.

In pursuit of the following investigations, pulverised sugar was employed. In making syrups, however, it is very apt to form a mass at the bottom of the vessel, thereby being liable to be burned where heat is taken to effect the solution. Crushed sugar has not this ten-

dency, and is, therefore, preferable in most cases. This sugar, as generally met with, is nearly dry: 20 grs. being exposed to a heat of 180° F. for two hours, lost ·19 grs., or ·95 per cent. The specific gravity of it was found, by several trials, to be 1·589. This result was ascertained by finding the weight of the bulk of a quantity of sugar compared with the weight of an equal bulk of nearly absolute alcohol. This liquid was taken on account of the almost insolubility of sugar in it; and, in order to guard against error which the small amount taken up might cause, the alcohol used was allowed to stand with dry sugar before being used.

A sample of the sugar, without previous drying, was found to have a specific gravity of 1·58, and, as this represents the officinal sugar, I have, therefore, used it in the succeeding investigations.

By calculation, 1 lb. of sugar will be found to equal 8 fluid ounces. Thus, 1 lb. = 5760 grs.; dividing this by its specific gravity (5760÷1·58) its bulk in grains will be 3645·569, which, divided by 455·69 grs., the number of grains in a fluid ounce, gives 8 fluid ounces. I have, however, found that, when sugar is dissolved in water, it occupies a less space than above stated, showing a slight condensation. This was ascertained by direct experiment, and verified by calculation, as follows:—By trial, 5760 grs. of sugar and 3094 grs. of water gave a syrup having a specific gravity of 1·319; made from these quantities, the syrup weighs 8854 grs., and, as its specific gravity is 1·319, its bulk is $(\frac{8854}{1·319})$ 6712·6 grs.; subtracting from this the bulk of the water, we have 3618·6 grs. for the bulk of the sugar, or $(\frac{3618·6}{455·69})$ 7·941 fluid ounces.* This divided into its weight $(\frac{5760}{3618·6})$ gives 1·591, which represents the apparent specific gravity of sugar in this solution occasioned by condensation. In solutions, however, of different densities, the condensation varies, being greater in proportion as the quantity of sugar diminishes. A few results are given below, taken from several experiments.

In a solution of 10 per cent. of sugar, the apparent specific gravity, arising from a greater degree of condensation, equals 1·613.

In one of 25 per cent.	. .	1·608 sp. gr.
„ 50 „	. .	1·602 „
„ 65 „	. .	1·593 „

The bulk of 12 ounces of sugar in solution has been shown to equal 7·941 fluid ounces; it may, therefore, for all practical purposes, be considered that two-thirds of its weight will equal its bulk in fluid ounces. As the idea generally prevails that half of its weight equals its bulk, this fact may be of some importance.

As the above-mentioned differences in the condensation of sugar were ascertained by experimenting with various per-centages, I have collected these together, and formed the following table:—

Table of the Specific Gravity of Sugar in Solution, 60° F.

Per-centage of Sugar.	Specific Gravity.	Per-centage of Sugar.	Specific Gravity.
0 . .	1·000	40 . .	1·1778
5 . .	1·0191	45 . .	1·2043
10 . .	1·0391	50 . .	1·2310
15 . .	1·0600	55 . .	1·2597
20 . .	1·0812	60 . .	1·2889
25 . .	1·1045	65 . .	1·3191
30 . .	1·1281	70 . .	1·3503
35 . .	1·1526		

As the experiments in this essay were chiefly made in reference to pharmacy, the conclusions arrived at are as follows:—That in many formulæ the proportion of sugar employed is either too great or insufficient; while in others, the quantity of fluid preparation, when made, does not bear that proportion to the drug or active principle which was evidently intended.

Syrup made according to the officinal directions will crystallise, unless in very warm weather, and will have a specific gravity of 1·327, instead of 1·319. If a syrup that will not deposit crystals, and having a density of about 1·320, be chosen, the following formula will meet these requirements:—

Dissolve with heat, sugar 36 ounces, water 20 fluid ounces; when finished, this should be made to measure 44 fluid ounces, or weigh 55 ounces by the addition of water if necessary.

The following formulæ may prove useful to the apothecary:—To make a pint of syrup of 1·320 specific gravity, take 13¼ ounces of sugar and 7⅜ fluid ounces of water. 1 lb. avoirdupois requires 8⅛ fluid ounces of water, and should measure 17¾ fluid ounces. In all these cases the amount lost by evaporation is to be made up by the addition of water.

* In the preceding calculation, 1 lb. of sugar is shown to have a bulk of 8 fluid ounces, while here in solution it has only 7·941 fluid ounces.

On the Preparation of Artificial Mineral Waters.

(*Continued from page 282.*)

Vichy Water.

The imitations of Vichy water sold are generally simple solutions of bicarbonate of soda with a slight excess of carbonic acid. Bicarbonate of soda, however, although the principal, is but one of many salts contained in these celebrated springs. Some of these salts, as the carbonates of manganese and strontia, and the borate of soda, are omitted from the amended formula of the Paris Codex; but some ingredients are now introduced which give a character to the water, that might be seriously impaired by their omission. The following formula is calculated from the mean of seven analyses of the various springs at Vichy, made by M. Bouquet:—

	Grammes.
Carbonate of soda (crystallised) .	. 11·180
Carbonate of potash . . .	. 0·263
Sulphate of magnesia (crystallised).	. 0·540
Chloride of calcium (fused) . .	. 0·436
Chloride of sodium . . .	. 0·130
Arseniate of soda (crystallised) .	. 0·005
Iron filings	. 0·001
Water	One litre.

The carbonates of soda and potash, the chloride of sodium, and arseniate of soda are to be mixed and dissolved in a small quantity of water. The sulphate of magnesia and chloride of calcium are to be dissolved in another portion of water, and the two solutions are to be poured into a bottle containing the remainder of the water and the iron filings. Carbonic acid is then to be passed in until the gauge shows a pressure of five atmospheres. In this way a clear water, which will keep well, and which has an agreeable taste greatly resembling the natural water, is obtained.

Sedlitz Water.

The Sedlitz water of the Paris Codex differs from our own in being merely an aërated solution of sulphate of magnesia, which, we need hardly mention, much more nearly resembles the natural water than the solution of potassio-tartrate of soda. The dose of the sulphate of magnesia prescribed by the Codex is 30, 45, or 60 grammes, and carbonic acid is passed until a pressure of three atmospheres is shown.

Another mode of producing aërated Sedlitz water, according to the Codex, is to liberate the carbonic acid in the bottle by the action of tartaric acid on bicarbonate of soda. In this case, as the tartrate of soda formed is a purgative salt, the dose of sulphate of magnesia is diminished, and the formula is as follows:—

Sulphate of magnesia .	26, 41, or 56 grammes.
Bicarbonate of soda .	4 grammes.
Tartaric acid . . .	4 grammes.
Water	A bottle.

Fluid Magnesia.

This liquid, as all our readers know, is a solution of bicarbonate of magnesia in an excess of carbonic acid, and is prepared by dissolving recently precipitated carbonate of magnesia under pressure. The Codex directs the solution of magnesia to be heated to boiling before the solution of carbonate of soda is added. After well washing, the precipitated carbonate of magnesia is drained, and placed in the apparatus. For a strong solution which will contain 24 grammes of the carbonate in solution, a pressure of seven or eight atmospheres is necessary, and it is recommended that the solution remain twenty-four hours after the gas is passed in before it is bottled, being repeatedly shaken during the time. The authors of this report took some trouble to ascertain the nature of the precipitate which, notwithstanding the great excess of carbonic acid, often rendered the solution turbid in the first stage of the operation; and they found it to consist of carbonate of lime and oxide of iron, impurities from the sulphate of magnesia and carbonate of soda. Carbonate of lime, when precipitated hot, takes the form of arragonite, and dissolves with great difficulty in carbonic acid water. Care should be taken, therefore, to use sulphate of magnesia which is as free as possible from sulphate of lime.

On Chloroformic Solution of Gutta Percha, by William Hodgson, *Jr.*

Take of gutta percha, in small slices, an ounce and a-half; chloroform, twelve fluid ounces; carbonate of lead, in fine powder, two ounces. To eight fluid ounces of the chloroform contained in a bottle, add the gutta percha, and shake occasionally till it is dissolved; then add the carbonate of lead, previously mixed smoothly with the remainder of the chloroform, and, having shaken the whole thoroughly together several times, at intervals of half-an-hour, set the mixture aside, and let it stand for ten days, or until the insoluble matter has subsided, and the solution has become limpid, and either colourless or of a slight straw colour. Lastly, decant, and keep the solution in a glass stopped bottle.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY.

*Wednesday, December 3.**

Mr. P. Squire, *President, in the Chair.*

A paper on "*Petroleum, or Earth-oil; its Origin, Discovery, Manufacture, and Commercial Value,*" by Mr. T. Holmes, U.S., was announced, but at the hour of meeting the author had not arrived.

The President, therefore, in allusion to what passed at the last meeting, said, that if any member present who took part in those proceedings would now repeat the statement made, he would be happy to give any necessary explanation. As no one responded, the President, after expressing his disappointment and regret at the silence, continued:—It was stated at the former meeting that some persons concerned in framing the British Pharmacopœia were making an unfair profit by selling, before the book is published, a Linimentum belladonnæ, the formula for which is to be contained in the new Pharmacopœia. The allusion to himself was unmistakable; but he was now prepared to show that, as far as he was concerned, there was not the smallest foundation for the charge. The facts of the case were shortly these:—About two years ago he had a large quantity of dried belladonna-root for the purpose of making atropine, and it had occurred to him that an alcoholic solution of the root might be found useful as an anodyne external application—a liniment made with a vegetable extract not being a nice preparation to use. He accordingly recommended such a liniment to some Medical friends, who prescribed it, and found it effective. After two years' experience with it, he had recommended it to the Pharmacopœia committee, who had adopted it with an addition. His (Mr. Squire's) liniment, therefore, was not the Pharmacopœia liniment; neither was it a quack or secret remedy, for the label attached to the bottle when it was sold clearly stated that it was a plain alcoholic solution of belladonna root.

[Mr. Vizer entered the room at this moment, and a bottle of the liniment he had obtained from Mr. Squire's establishment was handed round. The printed label upon the bottle was as follows:—"Linimentum Belladonnæ: A fluid ounce equals 1 oz. Belladonna Root. It is about ten times the strength of Tinct. Bellad. P. L. Miscible with Soap Liniment.—Not with Oil."]

Nothing (said Mr. Squire) could be more explicit than that label. With that before him, any one, in the least degree acquainted with pharmacy, could set to work at once and make the preparation.

Mr. Vizer said he regretted that he was not in the room when Mr. Squire opened the subject, as he should have given Mr. Squire the full advantage of the facts which had come to his knowledge since the last meeting. Two bottles of the Lin. belladonnæ in dispute had been obtained at Mr. Squire's establishment before the meeting; but on sending a third time, the day after the meeting, for Lin. Belladonnæ Pharm. Britt., the assistant who served the article remarked to the purchaser, that he did not understand the order; nevertheless, it was allowed to pass. As a proprietary article, he granted that Mr. Squire had an undoubted right to sell his liniment, and keep the preparation secret; but when it was prescribed by physicians as Lin. Belladonnæ Pharm. Britt., then he denied that Mr. Squire had any right to its exclusive sale; nor ought he to have sold, as the Pharmacopœia liniment, that which he admitted was not the Pharmacopœia preparation. Mr. Vizer then said, he felt it his duty, on public grounds, to ask Mr. Hills, whom he saw present, whether a belladonna liniment, professedly of the British Pharmacopœia, had ever been prepared and sold in his establishment? If Mr. Hills denied it, there was an end of the matter, and he (Mr. Vizer) was fully prepared to apologise for even mentioning Mr. Hills' name in connection with the matter. But if it could not be denied, he should like to know how it happened that both Mr. Hills and Mr. Squire had a proprietary preparation of the same name?

Amid some interruptions from calls of "question" and "order," Mr. Vizer proceeded to say, that he was sorry to see respectable chemists and druggists, of the standing of the gentlemen named, mixed up with a matter of this kind, and asked what the late Mr. Bell would have thought of such proceedings? He believed that Mr. Bell would have shrunk from them with abhorrence; and he wished

* We think it right to state that our reports of meetings are not given as *verbatim* reports; but great care is taken to give accurately the substance of the remarks made, and never to exceed the exact force of the words used.

he could see, in Mr. Bell's position, one who exhibited the same single-hearted devotion to the general interests of Pharmaceutical chemists and the Pharmaceutical Society, for he really believed the Society was on its last legs.

Mr. Hills said he wished for no apology from Mr. Vizer for mentioning his name. He admitted at once that a liniment called "Linimentum Belladonnæ Pharm. Britt." had been prepared and sold in his establishment. It happened in this way: In the ordinary course of business a prescription, in which the preparation was ordered, was brought to his establishment. The assistant, into whose hands the prescription came, of course, knew nothing of the preparation; and he, therefore, as he was bound to do sent to the physician who wrote the prescription, for the formula. The physician gave the formula, and the prescription was dispensed. For himself, Mr. Hills said, he had never seen either the formula or the preparation. He believed the physician had written the prescription inadvertently. He wanted to try the liniment and had prescribed it; but it was done entirely through inadvertence. Mr. Hills added that he had no private formulæ; and everything in his establishment was open to Mr. Vizer's inspection, if he would visit it.

Mr. Squire thought Mr. Hills' answer very straightforward, and one which must be perfectly satisfactory to Mr. Vizer. It was all Mr. V. could want. In his own case he had said that his young men believed that the Lin. belladonnæ he prepared was the liniment adopted by the Pharmacopœia committee. But it was not so; an addition had been made. Neither his young men nor his son, however, knew of the alteration. His position as President of the Pharmaceutical Society, and representative of the Society in the Pharmacopœia committee, had compelled him to keep the exact formula secret.

Mr. Vizer: Why not publish the formula?

Mr. Squire said it could not be expected that the formula would be published before the Pharmacopœia came out. His own label was sufficiently explicit as to the composition of his own liniment.

Mr. Urwick said a suggestion made to the Pharmacopœia committee became the property of the committee, and Mr. Squire ought never to have alluded to it, even to his young men.

Mr. Squire asked whether, supposing Mr. Urwick had discovered a useful preparation, and had recommended it to the committee, he would, after making the suggestion, have dropped it? He repeated that his young men believed his own preparation to be that of the British Pharmacopœia, and had sold it accordingly. He had been eight years a member of the Pharmacopœia committee, and up to this time had steered through without exciting dissatisfaction.

Mr. Deane said that he had been chairman of the Pharmacopœia committee of this Society, and he could bear witness that all the time the committee sat every member exerted himself to the utmost to produce good results. There was no reserve—no desire to promote individual interests shown; and he wondered that any one should accuse a member of acting with the meanness insinuated. The whole affair was a matter of misconception. It was well known that the laws of the College of Physicians forbade a physician to prepare his own medicines. If a physician wished to try a remedy he was obliged to resort to a chemist to prepare it for him. In the present case, a physician had put the words "Pharmacopœia Brittanica" after a preparation inadvertently. The patient went to another chemist, who sent to the physician, and he gave the formula. There was no fraud—no dishonesty in the act. Mr. Deane concluded by remarking that all lived in glass houses, and it was the height of imprudence to cast stones.

Mr. Vizer admitted that, if a physician wished for a medicine for a special case, the course adopted was perfectly justifiable; but the belladonna liniment was prescribed publicly.

Mr. Bottle heard with much regret the attack made on the President behind his back at the last meeting. The matter should have been postponed until the President was present. If a preparation emanating from a pharmaceutical chemist was adopted in the Pharmacopœia, he thought it was a credit to the whole body of chemists. The prescription complained of was an indiscretion on the part of the prescriber. If it had fallen into his hands, he should have gone to the prescriber, and told him that he had prescribed something in advance of his (Mr. Bottle's) knowledge, and requested the formula. With regard to Mr. Squire's liniment, he considered that the label gave all necessary information respecting it.

Dr. Fraser said he had come to the meeting to hear a lecture on oil, but had been obliged to listen to a very acid discussion. He considered that a physician was justified in sending his patients where he pleased for their medicines. In the case under dispute, he thought that, although the prescriber might have overstepped the bounds of prudence, no blame could be attached either to him or to Mr. Squire.

A Member remarked that no physician had a right to order a preparation from a Pharmacopœia not yet published.

Mr. Squire observed that druggists had no right to criticise physicians.

The subject then dropped.

[We postpone the remainder of our report until next week.]

NOTICES OF BOOKS.

Jurors' Reports: International Exhibition: Class IV. *Section* D. *Perfumery.*

Notwithstanding a something reminding us of the talk of a barber's shop, which runs all through this report, and a good deal that will be found in the paper Mr. Rimmel read at the Society of Arts (Chemical News, vol. i. p. 307), we feel bound to say that it is an interesting, well-written production, containing a good deal of useful information, which will be read with pleasure, and which does the author much credit. If any reader has a doubt about the dignity and importance of the subject, let him look at the first sentence:

"Perfumery is the art of collecting all the various fragrant substances diffused throughout nature, of rendering permanent those which are volatile, by fixing them into some solid bodies, and of presenting the whole in an available and convenient shape for the purposes of the toilet or for the gratification of the olfactory organs."

No one will wonder that such an art should succeed in asserting for itself a proper position, and that, although "in former Exhibitions perfumery was classed in different ways, sometimes with miscellaneous articles as in 1851, sometimes with chemical products as in 1855, it now has obtained, for the first time, in the present Exhibition—thanks to the exertions of the London perfumers—the privilege of forming a separate sub-class; a distinction it is entitled to, not only from the importance of its trade, but also on account of the nature of its manufacture, which is totally different from any other."

There is much in the report, as we have said, which is interesting; but we prefer to quote for our readers that which may be useful. Here, for example, is a passage which would answer many questions that are occasionally put to us by correspondents:—

"Toilet soaps, being now in universal use, have become one of the most important branches of the perfumer's trade. There are four kinds of soaps made for toilet purposes: hard soap by the hot process, hard soap by the cold process, soft soap, and transparent soap. The first, which is also called the large-boiled process, because it is generally

made in considerable quantities, consists in boiling grease or oil, and sometimes a small proportion of rosin, with an excess of soda-lees. The lees are drawn or pumped out when exhausted of their alkali, and fresh ones added, until the whole mass becomes saponified. In foreign countries they perfume the soap thus made when poured into the frame where it is placed to cool; but in England it is customary to re-melt it, and perfume it then, which, no doubt, improves the quality. The second way of manufacturing hard soap is by the cold process, which is also called the small-boiler process, it being necessary to make it in vessels of small dimensions, for the facility of working. It consists in mixing fat liquefied to a milky consistency with a fixed dose of concentrated soda-lees, in the proportion of one-third of lees to two-thirds of fat. The mass is kept at a gentle heat, and constantly stirred for about two hours, and then poured into a frame, where the saponification becomes complete. Mutton suet or lard is generally used for this purpose; the latter produces a soap of a finer grain. This process is not generally so much esteemed as the other; but yet, when the fat and lees are perfectly pure, and the doses nicely calculated, it may produce as good a soap as the hot process, but it requires to be kept some little time to become perfect. It offers a certain advantage to perfumers for producing a delicately scented soap, by enabling them to use as a basis, instead of fat, some pomade obtained from flowers, which could not be done with the other process, as the heat would destroy its flavour. Soft soap, known in the trade under the name of 'saponaceous cream,' or 'cream of almonds,' is also made by the cold process, and consists in a mixture of lard and a little cocoa-nut oil with potash-lees. Transparent soap is a combination of hard soda soap with alcohol. A soft transparent soap may also be made by substituting potash-soap for soda-soap. Soaps are usually perfumed with essential oils of a cheap description, such as those distilled from aromatic plants or spices, to which are sometimes added balsams or tinctures. They are coloured in various ways to suit the tastes of the markets for which they are intended. The new mauve dyes have been tried with them, and found to succeed very well with the violet colour, but the pink is apt to fly. There are some soaps, however, in the Austrian department, which have a rosy hue, apparently produced by one of those dyes."

Here is another passage from the author's remarks on British productions :—

"The British manufacturers of perfumery make a very creditable show, which manifests great improvements in that trade since 1851. The removal of the excise restrictions on soap-making have no doubt operated very favourably in allowing perfumers either to manufacture their own soap, or to have it made for them of the most suitable ingredients for toilet purposes. The greater part of the English scented soaps exhibited are made by the hot process from tallow or palm oil and soda-lees. A small quantity of rosin and cocoa-nut oil is generally added. The former renders the soap softer and easier to work, increasing at the same time its detergent properties. The latter gives it a fine grain and improves the lather, but it must not exceed a proportion of five per cent. on the fat used, as otherwise its fetid smell would become perceptible. The most celebrated of English soaps is the Windsor soap, which is not only much used for home consumption, but also exported largely to all parts of the world. It was originally a white soap, which turned slightly brown with age, but it is now coloured artificially with brown umber or burnt sugar. Honey soap is also made in considerable quantities. It is a tallow-soap, containing about five per cent. of rosin, and is perfumed principally with oil of citronella. It is an excellent toilet soap, but contains no honey. Several so-called glycerine soaps are also exhibited. Some made by the hot process, which evidently contain no glycerine (unless crushed in afterwards), as it is pumped out with the waste lees, others made by the cold process, which have retained all the glycerine of the fat, to which in some cases more has been added mechanically."

The following contains a good hint for manufacturers, which we hope they may profit by :—

"The perfumes exhibited are mostly of good quality, the alcohol used for their basis being generally distilled from grain, and perfectly inodorous. It was formerly thought that spirits distilled from wine (usually called Montpellier spirits) were the best for perfumery purposes; but the principal houses have now adopted grain spirits, as being the most neutral, and free from that œnanthic flavour inherent to spirits of wine, which is liable to impair the fragrance of very delicate perfumes. Now even French perfumers are beginning to use English grain alcohol to make their best perfumes.

"The toilet preparations exhibited in the British department are mostly deficient in that outward attractive appearance which is the distinguishing feature in foreign preparations; but this does not affect the quality, which is generally good. The principal novelties we noticed were the happy introduction of glycerine into some toilet articles, and a new method of fumigation by volatilising fragrant molecules through a current of steam."

We looked to the notice of the Australian Department, in the hope of seeing some account of a remarkable article which caught our eye in the Victorian exhibition, "Atmospheric Oil for Promoting the Growth of the Hair," —"The 'air of the 'ead, not the hair of the hatmosphere," as *Punch's* barber would say. But we suppose the author overlooked it, or, like ourselves, considered it only the production of a sharp-witted Australian who was trying to raise the wind.

We recommend all our readers interested in the subject to get this report. It only costs sixpence, and is better worth the price than any of the reports we have yet read.

NOTICES OF PATENTS.

2348. *Paper.* Theophilus Redwood, Montague Street, Russell Square, London. Dated September 19, 1861. (Not proceeded with).

For the purpose of preventing the injurious action of chlorine, or compounds of the same, upon paper made from pulp, bleached in the ordinary manner, the inventor uses the sulphite of zinc, which is mixed with the materials in the proportion of five per cent, by weight, calculated upon the dry ingredients. The quality of the paper is said to be generally improved by such addition.

2351. *Improvements in the Mode of Obtaininy Certain Chemical Substances, and in the Treatment of Vegetable Fibre, and in obtaining Manurial and other Products therefrom.* J. Oliver, Colchester; J. Grantham, Nicholas Lane, London; W. Sinnock, Woodford; and M. R. Leverson, St. Helen's Place, London. Dated September 20, 1861.

This invention relates to the employment of carbonate of soda and chloride of lime as agents for the removal of extraneous matters in the treatment of fibrous vegetable substances, with the object of manufacturing therefrom a kind of pulp, suitable for making every description of paper, and for moulding into various shapes in imitation of *papier maché* goods. Another part of the invention refers to the economical application of the residual saline and organic matters, such mixed ingredients being associated with earthy phosphates and nitrogenous compounds for the purpose of rendering them more valuable and efficacious when employed as manure.

There is no doubt regarding the practical utility of such

a process as that above described, in the event of a suitable fibrous material being found; it has not yet, however, been conclusively demonstrated that the finer descriptions of paper can be manufactured directly from these vegetable sources. The employment of alkaline carbonates and chloride of lime in the preliminary operation of extracting and purifying the fibre or pulp, has already been made the subject of several patent claims.

Grants of Provisional Protection for Six Months.

2966. Frederick Trachsel and Thomas Clayton, Manchester, "Improvements in machinery or apparatus for obtaining light, heat, and ventilation, parts of which improvements are also applicable to other purposes."

3010. Charles Otto Heyl, Berlin, Prussia, "Improved means and machinery to be used for the purpose of extracting fatty oils from oleaginous seeds, and for purifying the said oils, and for extracting the agents employed from the exhausted residue."

3062. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in preserving provisions."—A communication from Alfred Henry Rémond, Paris.

2056. Richard Archibald Brooman, Fleet Street, London, "Improvements in generating heat in furnaces and fire-places."—A communication from William Elijah Hagan, Troy, U.S.—Petition recorded July 18, 1862.

2904. Charles Stewart Duncan, Inverness Road, Bayswater, Middlesex, "An improved compound or material for coating or covering metallic and vegetable substances to preserve them from corrosion or decay."—Petition recorded October 28, 1862.

2982. Peter William Reuter, Buckland Crescent, St. John's Wood, London, "Improvements in dyeing."—A communication from Edward Reuter, Paris.—Petition recorded November 4, 1862.

3011. William Clark, Chancery Lane, London, "Improvements in the means of utilising refuse and azoted matters of commerce."—A communication from Messrs. Amédée Gelis and Lucien Dusart, Boulevart St. Martin, Paris.

3017. George Henry Ogston, Mincing Lane, London, "Improvements in treating nitrous acid and nitric oxide in order to convert them into nitric acid."

3021. Edward Sonstadt, Stewart Place, Alfred Street South, Nottingham, "Improvements in the manufacture of the metal magnesium."

3041. Edward Marriott, Miles Platting, and Samuel Holroyd, Manchester, "Improvements in the purification of gas, and in obtaining certain useful products therefrom."—Petitions recorded November 11, 1862.

Notices to Proceed.

2056. Richard Archibald Brooman, Fleet Street, London, "Improvements in generating heat in furnaces and fire-places."—A communication from William Elijah Hagan, Troy, U.S.—Petition recorded July 18, 1862.

2059. George John Yates, and John William Ward Tindall, Liverpool, "A process of deodorising paraffine, coal, pitch, rock, and other like oils and hydro-carbons."—Petition recorded July 19, 1862.

2155. Michael Henry, Fleet Street, London, "Improvements in obtaining fibrous materials and paper pulp, in treating, cleansing, and scouring fibrous materials and fabrics manufactured thereof, in producing soap for the said operations, and in obtaining products from liquors used therein."—A communication from Jean Baptiste Vasseur and Victorien Joseph Janssens, Boulevart St. Martin, Paris.—Petitions recorded July 29, 1862.

2199. William Clark, Chancery Lane, London, "Improvements in the purification of water, and in apparatus employed therein."—A communication from Mr. Maurice Laschi, Boulevart St. Martin, Paris.—Petition recorded August 5, 1862.

CORRESPONDENCE.

The Use of Methylated Spirit in Pharmacy.

To the Editor of the Chemical News.

Sir,—I am glad to see that you purpose to take some notice of the abuse of the use of methylated spirit, a subject which, I think, would better merit discussion at a pharmaceutical meeting than earth oils, or even the squabble about the Linimentum belladonnæ. After Professor Redwood's remarks at the last meeting but one, I was in hopes that the subject would be brought on for discussion, but it was deferred; and I am told that leading members of the Society sell methylated chloroform mixed with methylated spirit for chloric ether. Surely, this is an abuse of the use of methylated spirit, and so a fraud on the Excise; and, moreover, a pleasant and valuable remedy is changed into a filthy and disgusting compound.

I shall be glad to hear your opinion as to the general use of methylated spirit for tinctures, for I sometimes hear druggists speak in favour of it.

I am, &c. M. P. S.

London, December 5.

[We most emphatically condemn the use of methylated spirit in everything but preparations for external application, and the proper fragrance of some of these, *e.g.*, Lin. camph. co., would be spoiled by the use. To employ it for tinctures is clearly wrong, and a use the Commissioners of Excise never contemplated.—Ed.] *C. N.*]

Theory of the Manufacture of Soda.

To the Editor of the Chemical News.

Sir,—I have carefully studied the articles which have appeared in Nos. 155 and 156, on the "Theory of the Manufacture of Carbonate of Soda." In the last one, I see the author supposes the following equation to hold true:—

$$2NaO,SO_3 + 3CaO,CO_2 + 9C = 2NaO,CO_2 + CaO + 2CaS + 10CO.$$

In my humble opinion this is proved by practice; but I would be permitted to ask the following question:—Referring to "Miller's Chemistry" on this subject, I find it stated, that "the water for lixiviation must not be employed at a temperature exceeding 110°"; the reason here assigned being that, if the temperature was higher, it would decompose the oxy-sulphide of calcium. Now, taking it for granted that no oxy-sulphide is, in reality, produced, but only lime and a sulphide, both being perfectly distinct, what is the reason that the temperature of the water must be not above 110°? Is it that the sulphide, although insoluble in water at ordinary temperatures, is partly dissolved by warm water? If any of your correspondents would answer this question I should feel much obliged. In continuation of this subject, I see that the caustic soda is only formed after the lixiviation by the reaction of the lime on the carbonate of soda. Might this formation of caustic soda not be prevented by using water charged with carbonic acid instead of pure water? The free carbonic acid would thus precipitate the lime as carbonate before it could act on the carbonate of soda. The gas might be forced in, under pressure, just at the moment of placing the soda ash in the water.—I am, &c.

A Beginner in Chemistry.

To the Editor of the Chemical News.

Sir,—In my communication "On the Theory of the Soda Process," which you were good enough to insert in your Number of the 29th ult., I omitted to notice the researches of Mr. J. W. Kynaston on this subject, which proved experimentally the correctness of the views I had so long

entertained of the composition of rough soda. Although these views had been referred to in the specification of a patent which I obtained in 1836, I have reason to know that Mr. Kynaston had not become acquainted with them when he communicated his very able paper to the Chemical Society, in 185—, in which he demonstrated, by a set of elaborate and independent experiments, that the surplus proportion of lime contained in rough soda (black ash), as ordinarily manufactured, does not exist in combination with sulphide of calcium.

I may also notice that Mr. Arrott (Messrs. Huson and Arrott, analytical chemists, Liverpool) has made black ash, in which the decomposition of the sulphate of soda was well effected, and the liquors obtained by its lixiviation contained very little sulphide of sodium, by the use of only one equivalent of carbonate of lime for each equivalent of sulphate of soda; whilst, if Dumas' hypothesis were correct, these liquors should have contained little besides sulphide of sodium.—I am, &c.

William Gossage.

The British Pharmacopœia.

To the Editor of the Chemical News.

Sir,—We think the trade ought to be made aware of the fact, that another liniment is in use, namely, *Lin. Aconiti Pharm. Britt.*: the formula is precisely the same as the *Lin. Bellad.*, substituting aconite root.—We are, &c.

Curtis & Co.

48, Baker Street, London, W.

Voltaic Battery with Triple Contact.

To the Editor of the Chemical News.

Sir,—Can any of your correspondents oblige me by informing me how to construct a voltaic battery with "triple contact?"

The following is an extract from the *American Journal of Science and Art*, vol. xxiii., page 442:—

"A battery, called a 'battery with triple contact.' One element of this battery consists of a glass or stone-ware cup, at the bottom of which there is a plate of non-amalgamated zinc, communicating *without* by means of a conducting strip. Above the plate of zinc there is a spiral formed of a rolled copper plate, having an attachment for making connexions. A solution of sulphate of potash covers entirely a plate of zinc, and wets, to a *certain height*, the plate of copper. Immediately on making the connexions between the copper and zinc, an electric current is established, which *continues constant for several* weeks," &c., &c.

The inventor of this battery is an Italian—Francesco Selmi, Professor of Chemistry in the University of Turin.

I am, &c.

Electro-Chemist.

Webster's Process for Making Oxygen.

To the Editor of the Chemical News.

Sir,—Let me add a few words to the letter of "Inquirer," which appeared in last week's Number of the Chemical News. Has Mr. Webster, or have Messrs. Pepper and Campbell, ever tried the action of a regulated temperature upon a mixture of nitrate of soda with peroxide of iron, instead of oxide of zinc? The residual soda is not in this case contaminated with immense quantities of a metallic compound, the presence of which quite unfits the product for soap-makers' use. I confess that I have been totally unable to discover any advantages in Webster's process: the prospectus of the company exhibits, indeed, a lamentable ignorance of the first principles of chemistry. One instance will suffice. The residue of the charge after each operation is recommended to be exposed to the air, that the zinc may recover its lost oxygen!!! I was not aware that deflagration with cubic nitre was deemed a process of *reduction*; or that, at the ordinary temperature, the atmosphere was a more highly oxidizing medium than Webster's oxygen mixture at a low red heat. It is not a flattering estimate, to say the least, of the powers of this new process.—I am, &c.

Another Inquirer.

To the Editor of the Chemical News.

Sir,—I beg to remark, in answer to "An Inquirer's" letter in your last paper, that, had he calculated the weight of the gas got by Dugald Campbell, Esq., he would have found the results perfectly correct; thus, 158 cubic feet of oxygen gas weighs 13 lbs. which, added to the 37 lbs., of residue in the retort, is exactly 50 lbs. This shows how carefully the experiments must have been done, as the result could not have tallied more correctly with the quantity of material used had it been calculated on purpose to agree. It is a voucher for the purity of the materials and the truth of the experimentalist.—I am, &c.

A Chemist.

Simpson and Others v. *Wilson and Another.*

To the Editor of the Chemical News.

Sir,—We shall be glad if you will allow us to state, for the information of your readers who have taken an interest in the result of our recent trial, that *ten* of the twelve jurymen expressed their desire to give a verdict in our favour.

We have no wish to make any comment upon the evidence; but we may mention, that we are determined to defend Medlock's patent *to the utmost*, and shall take proceedings against *all* persons who employ *arsenic acid* for the production of "Magenta" dye.—We are, &c.

Simpson, Maule, and Nicholson.

9, Fenchurch Street, London, E.C., Dec. 11.

MISCELLANEOUS.

UNIVERSITY OF LONDON.

The following are lists of Candidates who have passed the respective Examinations indicated:—

SECOND B.A. EXAMINATION.—EXAMINATION FOR HONOURS.

Chemistry.

Alexander Morrison Thomson (prize), private study; Henry Summerhayes, St. Thomas's Hospital.

SECOND B.SC. EXAMINATION.—PASS EXAMINATION.

First Division.

William Lant Carpenter, B.A., private study; John Clifford, B.A., University; William Hackney, University; Arthur Reynolds, Royal College of Chemistry; Frederick Thomas Roberts (first M.B.), University; William Marshall Watts, Owen's.

Second Division.

John Dolleymore, B.A., private study; William Howse Groser, King's; John Wale Hicks, B.A., St. Thomas's Hospital; Benjamin Kisch, B.A., University; Gustav Knecht, private study; Charles Barnes Upton, B.A., Manchester New, and University; Rayner Winterbotham, B.A., University.

EXAMINATION FOR HONOURS.

Mathematics and Natural Philosophy.

Benjamin Kisch, B.A., University.

Chemistry and Biology.

William Marshall Watts, Owen's; John Wale Hicks, B.A., St. Thomas's Hospital; William Hackney, University.

Logic and Moral Philosophy.

Frederick Thomas Roberts, University; John Clifford, B.A., University; John Wale Hicks, B.A., St. Thomas's Hospital.

Geology and Palæontology.

William Hackney (University Scholarship), University; Arthur Reynolds, Royal College of Chemistry; Frederick

Thomas Roberts, University; John Wale Hicks, B.A., St. Thomas's Hospital, and John Clifford, B.A., University (equal); John Dolleymore, B.A., private study.

Storing of Petroleum.—The Commissioners of Sewers of the City, on Tuesday last, refused licences to store petroleum to Mr. C. Hawkins, of Bishopsgate Street, and Messrs. Blundell, Spence and Co., of Upper Thames Street. The Commissioners seem disposed to prevent altogether the storing of petroleum within the City of London.

Simpson and Others v. Wilson and Another.—This important trial took place in the Court of Queen's Bench, at Guildhall, on Tuesday and Wednesday last, and occupied the whole of both days. After consulting two hours the jury could not agree to a verdict, and there appearing to be no chance of their ultimate agreement, the Lord Chief Justice discharged them. Through the kindness of the plaintiffs, we shall be able to give our readers a fuller report of the scientific evidence than we had intended.

Mr. W. Herapath v. Dr. W. B. Herapath.—We are requested to make known that the analysis in the case of the alleged poisoning in Wiltshire was made by Dr. William Bird Herapath, and not by Mr. William Herapath, for whose examination the matters were intended. It is greatly to be regretted that the Herapaths—father and son—cannot compose their differences, so as to prevent these mistakes and scandals. *Mr.* Herapath's address is Old Park, Bristol.

The Oil Springs of America and Canada.—*Remarks.*—A hurried postscript to my last week's circular announced that exciting news from New York had much advanced us here. The business in refined, as will be read below, has been very extensive, and it would have been equally so in crude had we any stock of moment to operate in. We are now 6d. to 9d. above the paraffine oil, and it will be interesting to see whether this disparity in price will or will not drive consumers back again to the British nondescript. But for the sterling enterprise of our foremost Liverpool merchant in this trade, the country would have been completely denuded of this oil, and the refined petroleum business utterly frustrated in the very hour of its need. As it will now be getting late for the encouragement of the shipping of burning oil for this season, I would earnestly and respectfully beg my friends to study my other remarks, written, not from reflection only in the present, but from experience in the past. *Crude.*—About 500 casks of American have been sold at 22*l.* to 23*l.*, the latter chiefly, at which there are still cautious sellers. The scarcity of American, coupled with the rumour that the Canadian has now become facile of deodorisation, has caused the latter to be in more demand, and speculators have taken what few hundred casks were procurable on the spot at 13*l.* to 13*l.* 10s., while for arrival the cargoes of the *Levis* sold at 13*l.*, the *William and Joseph* (just arrived) at 13*l.* 10s. to 14*l.*, this latter price being refused for the *Tasman*. *Refined.*—5000 to 6000 casks have changed hands, spot and to arrive, at 2s. 9d. up to 3s. 3d., closing firm at 3s. to 3s. 3d. The stock is only about 5000 casks, which includes the 1600 casks arrived per *Ianthe* from Boston, and the 1300 casks per *Ellen* from New York. It must be remarked that some of the qualities are sadly deficient in their illuminating properties, owing to the over anxiety of the refiner to meet the requirements of the American and British Government's Act. All that is wanted is, to make the point of ignition above 100°; but if manufacturers distil it over safe, say 125° or 130°, it becomes too heavy, and yields in the wick during consumption. *Benzine or Spirit.*—This product is now in almost unlimited demand as a substitute for spirits of turpentine. The latter is in most request in early and late spring, hence there is timely notice to provide supplies of the former for the coming emergencies. The value to-day is 2s. 6d. to 2s. 9d. per gallon, in casks. There is no doubt but that the cask is the preferential package for trading in this article. Cases and drums, although admittedly superior conveyancers, will not find an equivalent value, so that shippers of this spirit must just see that the casks are the perfection of mould and make. Presuming that the war will continue, and that spirits of turpentine will remain somewhere about the present value, there is no reason why the business in this rock spirit, during the coming summer season, should not be as large as the refined oil during the winter. *Lubricating Oil.*—The challenge given to British demand for this description of petroleum has been extremely limited. Perhaps we are fifty times larger consumers than any other nation, yet we have had very little American to try our appreciation. It is true some few parcels have been sent over, but they have been either very mucilaginous, only semi-liquid, or else too light altogether. The oilometer, and not the hydrometer, should be the guide. By the former we range sperm 45°; olive, rape, and lard, 27° to 28°; and these weights should be accepted as the extremes of practical lubricants. An oil of the lowest of these densities, be the colour ever so black (if free from grit), would fetch 15*l.* per tun; green, 17*l.* 10s. to 20*l.*; brown, 20*l.* to 22*l.* 10s.; and yellow, up to 30*l.* Size of the package no object. *Wax* of all sorts attracts general attention, and there is a very current sale for any quantity, pressed or unpressed. The market is cleared of white block at 9d. Of yellow and shales we have none. The outlet for it in this country is very large, and it certainly is not exaggeration to assert that the sales of English, condensed from the boghead coal and the like, cannot be less than twenty tons per week! The severe weather experienced in America is all in favour of the precipitation of this article, which is the production of a low temperature, as the oil is of a high one. The perfect superiority of the petroleum over the paraffine wax is universally admitted by consumers of every kind. Insolubility is the proof of merit—a test readily acquired by the most uninitiated.—*From Alex. S. Macrae's Circular, Liverpool*, December 6.

ANSWERS TO CORRESPONDENTS.

H. O.—No two analysts, probably, would agree in the estimation of organic matter when much chloride of sodium is present. The differences pointed out are not extraordinary.

Query.—For such purposes a litre may be considered to equal a pint and three-quarters, and a gramme fifteen grains and a-half. A short calculation will give our correspondent the rest.

B. S.—1. Soluble in sulphide of ammonium. 2. To make sure of oxidation you must add a crystal or two of chlorate of potash. We propose to give some improved analytical tables in the course of next year.

R. S. T.—Probably electrical sparks. When steam escapes from a small aperture under considerable pressure, a large amount of electricity is developed. Armstrong's hydro-electrical machine resulted from the observation of this fact.

Alfred Stevens.—Vol. II. of the CHEMICAL NEWS contains several papers on the manufacture of benzole, nitro-benzole, aniline, and the colours derived from it. Papers on petroleum will be found in several Numbers of the current volume.

P.—There are some who pretend to know how to make chloroform miscible with water in all proportions. We do not know. Chloranodyne is partly a secret, but the compounder tells some of the ingredients.

Nemo.—A full account of the Electric Light applied to Lighthouses will be found in Dr. Faraday's Lecture, CHEMICAL NEWS, vol. I, p. 171. The objections to the Light are stated in the Report just issued.

A. Z.—Quinine is said to be a *poison*. The following is from the last edition of Beck's Jurisprudence: "I subjoin with great unwillingness, but borne down with weight of authority, *Sulphate of Quinine*. In large doses it would certainly seem to have proved poisonous to animals and to man. On dissection there is observed to be much congestion of the brain and lungs. In several instances, indeed, by Recamier, Baldwin, and others, blindness, convulsions, and delirium have occurred, and inflammation of the brain has been found." Tannin is the antidote recommended.

Received: Mr. Vizer; Alfred Stevens; E. G.; G. Bennett; Messrs. Simpson, Maule, and Nicholson, received with thanks; R. W. and Co.; Mr. W. Herapath.

THE CHEMICAL NEWS.

VOL. VI. No. 159.—December 20, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Re-agents Applicable to the Analysis of Alkaline Metals—Fluosilicate of Copper and Fluosilicate of Aniline, by MM. KNOP *and* WOLF.

ONE of these re-agents is ordinary fluosilicate of copper as well as the acid fluosilicate, which the authors obtained by boiling oxide of copper with fluosilicated alcohol. Dissatisfied with these reagents, or, at least, with the variations in their indications in presence of salts of potash, M. Knop has substituted fluosilicate of aniline, and, it appears, with great success.

To prepare this re-agent, dilute the aniline with twice its volume of alcohol at 80° to 90°; then add an equal volume of saturated fluosilicated alcohol. The liquid first becomes heated, and then almost immediately solidifies. Spread the mass in a capsule, dry in the air, and reduce to powder.

This powder is composed of the desired fluosilicate, and of all the silicic acid produced during the reaction. The acid being in its insoluble modification, one washing in water suffices to separate the soluble fluosilicate of aniline from the inert silica which remains on the filter.

If coloured aniline is used, the powder must be previously washed in ether, which dissolves only the colouring matter.

Fluosilicate of aniline crystallises in nacreous scales. Soluble in water, insoluble in alcohol and ether, this salt is very useful in separating potash from soda, and even from ammonia, provided the liquid is not overcharged with the latter. When so overcharged, the ammonia or its saline combination must first be expelled, by heating the capsule until the desired effect is produced.

In using this reagent, the matter to be reacted upon is first acidulated by hydrochloric acid. Absolute alcohol is then added. Potash is thus precipitated in the state of fluosilicate, even in presence of phosphoric acid.—*Chem. Centralblatt.*

On a New Preparation of Pure Oxygenated Water, by M. DUPREY.

BY passing a very rapid current of pure carbonic acid into distilled water, and adding at intervals binoxide of barium, perfectly pure oxygenated water is obtained.

When the quantity of carbonate of baryta is sufficiently large to obstruct the passage of the gas, the clear liquid, containing all the oxygenated water, must be decanted, and the current of carbonic acid again passed into it. As soon as more binoxide of barium is thrown in, a fresh quantity of oxygenated water is formed. In this way we obtain water strongly charged with perfectly neutral and pure oxygenated water, which can be concentrated under an air pump. Care must be taken to maintain a sufficiently rapid current of carbonic acid, so as to be always in excess of the small and gradually added quantities of binoxide of barium, which must, moreover, be finely powdered, as large pieces escape decomposition.

In all my experiments, the carbonic gas has been exactly washed by passing through flasks containing carbonate of lime. It is then evident that to its action alone is to be attributed the production of oxygenated water; and the experiment shows, moreover, that it can be obtained as well with oxacids as with hydracids.

The best re-agent I have been able to find for oxygenated water is decidedly permanganate of potash, which, when poured into water containing even a very small portion of oxygenated water, disengages all its oxygen. This body serves to estimate oxygenated water, the phenomena of decoloration being very apparent.—*Comptes-Rendus.*

New Re-agent for Salts of Protoxide of Tin and Arsenious Acid, serving for the Estimation of these Compounds, by M. TERREIL.

PROTOXIDE of tin dissolved in potash possesses the property of reducing cupro-potassic tartrate in the same way as glucose.

The sensibility of this re-agent is extreme; traces of protoxide of tin suffice to determine a deposit of protoxide of copper.

Given, a salt of protoxide of tin; the solution is treated with a slight excess of potash, so as to re-dissolve the precipitate first formed; cupro-potassic tartrate is added to the alkaline solution, and the whole boiled; an abundant precipitate of protoxide of copper instantly forms. When only traces of oxide of tin exist in the liquid, the precipitate, not apparent in the first few moments, collects, and becomes perfectly visible after standing ten or twelve hours.

During this reaction, the protoxide of tin passes to the state of stannic acid, and no longer reacts on the cupro-potassic re-agent.

Analysis proves that one equivalent of protoxide of tin reacting on two equivalents of binoxide of copper precipitates one equivalent of protoxide of copper, as shown in the following formula:—

$$SnO + 2CuO = SnO_2 + Cu_2O.$$

In other words, 1·000 in weight of protoxide of copper obtained by the reduction of cupro-potassic tartrate, corresponds to 0·937 of protoxide of tin, or 0·825 of metallic tin. Arsenious acid, dissolved in potash, also reduces the cupro-potassic re-agent, changing, meanwhile, to arsenic acid. Reduction does not take place so rapidly as with protoxide of tin; it is, however, complete. One equivalent of arsenious acid, while changing to arsenic acid, reacts on four equivalents of binoxide of copper, precipitating two equivalents of protoxide of copper.—

$$AsO_3 + 4(CuO) = AsO_5 + 2(Cu_2O).$$

1·000 of protoxide of copper, obtained by reducing the cupro-potassic re-agent, corresponds to 0·692 of arsenious acid, or 0·524 of metallic arsenic.

All other metallic oxides soluble in potash as well as sulphites, exercise no action on the cupro-potassic re-agent.—*Bulletin de la Société Chimique de Paris.*

TECHNICAL CHEMISTRY.

Simpson and Others v. Wilson and Another. Patents for Aniline Dyes.

As the shorthand writer's transcript of the above trial had not arrived at the time of going to press, we print the following specifications of patents, which will be found to be frequently referred to in the course of the proceedings:—

"1859, 10th December. No. 2800.

"*Preparation and Application of Azaleine to Dyeing and Printing.*

"Letters Patent to Rudolph Heilman, of the City of Manchester, in the county of Lancaster, Manufacturing Chemist, for the invention of 'The Preparation of a New Colour called Azaleine, and its Application to Dyeing and Printing.'—A communication from Jean Gerber Keller, of Mullhouse, in the Empire of France, a foreigner residing abroad. Sealed the 20th April, 1860, and dated the 10th December, 1859. (Void by reason of the Patentee having neglected to file a Specification in pursuance of the conditions of the Letters Patent.)

"'Provisional Specification left by the said Rudolph Heilman at the office of the Commissioners of Patents, with his Petition, on the 10th December, 1859.

"I, Rudolph Heilman, of the City of Manchester, in the County of Lancaster, Manufacturing Chemist, do hereby declare the nature of the said invention for 'The Preparation of a New Colour called Azaleine, and its Application to Dyeing and Printing,' communicated to me by Jean Gerber Keller, of Mullhouse, in the Empire of France, a foreigner residing abroad, to be as follows:—

"Azaleine is prepared in the following manner:—Take the commercial article known by the name of aniline, or the salts formed by that body with the oxyacids and the organic acids. Treat it while under the influence of heat in suitable proportions with any of the salts, acids, and oxides named hereafter. The salts can be used in the crystallised state, or dissolved in water or any other liquid.

"1st, the salts formed by the nitrogen oxyacids (such as nitric acid, hyponitric acid, and nitrous acids) and metallic oxides; 2nd, the salts formed by the oxyacids of sulphur, such as sulphuric, hyposulphuric, and sulphurous, and the metallic oxides; 3rd, the salts formed by the oxyacids of chlorine, bromine, and iodine, such as perchloric, chloric, iodic, bromic, and the metallic oxides; 4th, the salts formed by the oxyacids of phosphorus and the metallic oxides; 5th, the salts formed by the oxyacids of arsenic and the metallic oxides; 6th, the salts formed by the oxyacids of chrome and the metallic oxides; 7th, the metallic oxides alone, or combined with one of the above-mentioned acids or an organic acid; 8th, the following acids,—manganic, permanganic, ferric, plumbic, antimonic, antimonious, alone or in combination with bases.

"The colour is applied to tissues and fibres in the usual ways well known to dyers and calico printers in their trades."

"1860, 18th January. No. 126.

"*Red and Purple Dyes.*

"Letters Patent to Henry Medlock, of Great Marlborough Street, in the county of Middlesex, Analytical Chemist, for the invention of 'Improvements in the Preparation of Red and Purple Dyes.' Sealed the 13th July, 1860, and dated the 18th January, 1860.

"Provisional Specification left by the said Henry Medlock at the office of the Commissioners of Patents, with his petition, on the 18th January, 1860.

"I, Henry Medlock, of Great Marlborough Street, in the county of Middlesex, Analytical Chemist, do hereby declare the nature of the said invention for 'Improvements in the Preparation of Red and Purple Dyes,' to be as follows:—

"I mix aniline with dry arsenic acid, and allow the mixture to stand for some time, or I accelerate the operation by heating it to or near to its boiling point until it assumes a rich purple colour, and I then mix it with boiling water, and allow the mixture to cool; when cold, it is filtered or decanted. The aqueous solution which passes through the filter contains a red colouring matter or dye, while a tarry substance remains on the filter; this tarry substance, dissolved in alcohol, methylated spirit, or other suitable spirit, furnishes a purple dye. These solutions of colouring matter may be used at once in the process of dyeing, concentrated or diluted according to the tints required. The mixture of aniline and arsenic acid, after being heated, may be allowed to cool, and then forms a paste which may be preserved; when required for use, it is mixed with boiling water, and treated as above described.

"Specification in pursuance of the Conditions of the Letters Patent, filed by the said Henry Medlock in the Great Seal Patent Office on the 17th July, 1860.

"I mix aniline with dry arsenic acid, and allow the mixture to stand for some time, or I accelerate the operation by heating it to or near to its boiling point, until it assumes a rich purple colour, and I then mix it with boiling water, and allow the mixture to cool; when cold, it is filtered or decanted. The aqueous solution which passes through the filter contains a red colouring matter or dye, while a tarry substance remains on the filter; this tarry substance, dissolved in alcohol, methylated spirit, or other suitable spirit, furnishes a purple dye. These solutions of colouring matter may be used at once in the process of dyeing, concentrated or diluted according to the tints required. The mixture of aniline and arsenic acid, after being heated, may be allowed to cool, and then forms a paste which may be preserved; when required for use, it is mixed with boiling water, and treated as above described.

"I have found that the proportion of two parts by weight of aniline to one part by weight of arsenic acid yields a good result, but I do not confine myself to that proportion, as it admits of variation.

"Having now described the nature of my said invention, and in what manner the same is to be performed, I wish it to be understood, that what I claim is, the manufacture or preparation of red and purple dyes by treating aniline with arsenic acid as hereinbefore described."

*On the Adulteration of Food in America.**

YOUR committee have had occasion, the past year, to

* From the Report of the Adulteration Committee of the American Pharmaceutical Association.

examine some of the many articles sold as yeast powders, substitutes for cream of tartar, baking powders, &c.

Many of these are decidedly unwholesome and poisonous in their effects upon the system. We would caution all lovers of healthy bread to use sufficient care in the selection of substances from which to make this valuable "staff of life."

Some of the compounds referred to have been condemned by your committee, but it is understood that they are sold now to quite a considerable extent.

We give an analysis of one of these compounds, and do not hesitate to say that the use of such an article in the daily bread is, in our opinion, liable to be attended with serious trouble.

Analysis.—100 parts of this powder consist of—

Free phosphoric acid	6·53
Bone phosphate of lime and magnesia	26·00
Sulphate of lime	2·59
Sand	·76
Dextrine	64·12
	100·00

With the bone phosphates are included the usual phosphates of oxide of iron and silicate of lime present in bones.

The article is manufactured by calcining refuse bone-black, until the carbon has been consumed: the white powder is then finely ground and mixed with a definite proportion of crude phosphoric acid, obtained from another portion of bone powder; starch or ground rice is added, and the pasty mass is then carefully dried at a temperature allowing the acid to convert starch into dextrine.

One hundred parts of the powder, when mixed with solution of bicarbonate of soda, and the precipitate dried at the temperature of baking bread, afford 31·16 parts of bone phosphate of lime.

As the product of decomposition, when this compound is mixed with bicarbonate of soda, besides the phosphate of soda, is the salt called "bone-ash," which does not exist, as such, in any part of the healthy system, or in food, the article can hardly be considered highly nutritious.

This salt, the bone-ash, in the state in which it exists in the bread, must act in the digestive process as an absorbent of the normal phosphates in food, and in the secretions, both of which contain them, with never more than two equivalents of base; thus it is liable to produce derangements of a serious character. The large amount of the phosphate of soda, also, is an unnatural addition to food, and must be eliminated, certainly never digested.

The use of this compound in bread-making is simply, in effect, adding finely ground bone-dust and phosphate of soda to flour; the question which addresses itself to the judgment is, Will such bodies improve the flour as an article of food?

If this wholly unnatural mineral mixture can be used with impunity, alum and gypsum may be substituted for it, as being more cleanly, equally nutritious, and dispelling the thought that we are consuming a vegetable fertiliser as an addition to our food.

The subject of liquors is one to which we ask your attention very briefly. The past year we have had occasion to examine many specimens of wines, brandies, and liquors.

The amount of fraud in these articles is, as you are all aware, very considerable; but your committee believe that in one popular idea, at present of considerable weight in the community, there is a great error. We allude to the popular idea of strychnine in whisky. In a large number of whisky analyses made the past year, your committee have not been able to detect, in a single instance, the presence of the least trace of strychnine. This, of course, is only negative evidence to the extent of these analyses; but your committee have not been able to ascertain, from any reliable source, that the practice of using strychnine in whisky is ever followed.

The fact, also, that one part of strychnia will impart a sensible bitterness to 600,000 parts of water, would seem to preclude its being used for this purpose.

The practice of adulteration of liquors is, however, very largely followed.

From the volume called "Treatise on Wine Making," under the head of "Secrets to Vintners," we make the following extracts, showing the dangerous practices recommended sometimes for improving wine:—

"*To Hinder Wine from Turning.*—Put a pound of melted lead, in pure water, into your cask, pretty warm, and stop it close."

"*To Soften Grey Wine.*—Put in a little vinegar wherein litharge has been well steeped, and boil some honey to draw out the wax; strain it through a cloth, and put a quart of it into a tierce of wine, and this will mend it."

In one instance on record, in "Medical Transactions," vol. ii., page 80, Dr. Warren relates an instance in which thirty-two persons were made seriously ill by drinking wine adulterated with lead; of this number one person died, and another became paralytic. Your committee give here an analysis of brandy, which was made the past year. The specimen examined was powerfully acid to test, and not a trace of tannin could be discovered in it. The alcoholic distillate was loaded with fusel oil. Artificial oil of bitter almonds was also present. Sulphuric acid was also present, probably in the state of soluble sulphate in the water used in the manufacture of the compound.

Analysis yielded in 100 *parts*—

Alcohol, specific gravity ·793	57·00
Extractive and colouring matter	1·60
Water, by loss	41·40
Oil almonds, acetic ether, sulphuric acid, not estimated	traces.
	100·00

This was judged to be an entirely factitious article. Your committee know of other brandy, entirely factitious, sold the past year.

The past year has seen opium held at a high price. A case of opium has been met with liberally charged with shot. All the shot that could be sold at five and a-half dollars a pound, would be, of course, regarded as a mere pecuniary transaction—paying well. As a remedy, however, the opium would outweigh the lead in value.

A specimen of nitrate of silver, sold for a pure article by a New York house, contained but 30 per cent. of silver. If it had been the article represented, it should have yielded 64 per cent. of silver.

A fraud similar to this was alluded to in our last year's report.

The next article your attention is asked to is chloroform. During the past year your committee have met with chloroform made by a professed manufacturer of chemicals, and sold to a highly respectable drug house. This chloroform was found to contain more than 12 per cent. of alcohol, and its specific gravity was below 1·40.

The purchaser was not at all satisfied, and upon returning it, he was told that it was bought for a pure

article by the wholesale house, but from a source from which they did not usually purchase. It was invoiced "Pure Chloroform."

Upon further investigation, the explanation was given, "that no more alcohol was present than was necessary for its preservation, it having been found that a certain amount of alcohol was necessary for the preservation of chloroform."

PHARMACY, TOXICOLOGY, &c.

On the Presence of Arsenic in Commercial Preparations of Bismuth, by W. Bird Herapath, *M.D., F.R.S.L. and E.*

The recent case of arsenical poisoning in Wiltshire has brought prominently before the public the fact, that the processes adopted for the manufacture of the medicinal preparations of bismuth are very imperfect, and permit the presence in these most useful articles of the Materia Medica of large quantities of a highly dangerous and noxious substance, namely, arsenic in some form or other. It, therefore, becomes most desirable that the attention of manufacturers should be called to this circumstance, in order that they might produce an article free from such dangerous impurities. Since my return from Hindon, I have examined fourteen different samples of this medicinal agent, amongst which were preparations obtained from the dispensaries of the Bristol Royal Infirmary, the Bristol General Hospital, as well as samples from some of the first pharmaceutical establishments in this city, and Clifton also, and in each case I have invariably detected the presence of arsenic. Some of these samples have contained as much as 1 grain of arsenic in 43 grains of the article examined; others, only 1 grain in 100 grains. Such quantities, although minute when given in the usual medicinal doses, yet, under a similar combination of circumstances as those occurring in that case, might lead to very serious consequences, as it would be impossible to establish the fact of a criminal administration of this poison, if bismuth, in its present impure state, had been administered medicinally.

Some preliminary experiments have shown me that it is possible to remove the arsenical impurities by a very simple process, and one which would not add much to the cost of the material. On boiling either of the insoluble salts of bismuth with sufficient quantity of solution of caustic potassa or soda, the arsenic is quickly removed in the soluble form; and the residue, on treatment a second time with the same re-agent, and subsequently well washing by means of large quantities of water and decantation, is rendered perfectly pure, and fit for medical purposes. I am not aware whether this process has been hitherto proposed, but it has succeeded perfectly in purifying some samples of nitrate and carbonate upon which I have tried it in my own laboratory.

The occasional existence of arsenic as an impurity in the bismuth of commerce was a fact well known to me; but it was not until after my return from giving evidence before the Wiltshire magistrates that I became acquainted with the fact of its almost universal presence; and permit me to express my acknowledgments to Dr. B. W. Richardson for having called my attention to this circumstance, and my subsequent experiments have fully confirmed the truth of his observations.

It is not for me to decide whether this was the source of all the poison in the case in question; however, *I think not*, for we should then have to imagine that at least one ounce of impure bismuth had been taken by the patient in order to account for the quantity of arsenic found by me; and, although all the *arsenic had been retained* in the viscera of the deceased, yet, by some extraordinary means, the whole ounce of bismuth had been evacuated, with the exception of a mere trace, for scarcely the one-twentieth part of a grain remained—a difficulty which, in my opinion, it is impossible to overcome.

On the Presence of Piperine in the Schinus Mollis, by M. Landerer.

The berries and leaves of the *Schinus Mollis*, one of the most graceful of the Eastern terebinthenaceæ, have a burning flavour, similar to pepper, whence it has obtained among the natives the name of "pepper tree." Every part of this vegetable is filled with a milky, very acrid juice. The leaves bruised and applied to the skin produce the effect of a strong sinapism.

In searching for piperine in the berries, which resemble Indian pepper, M. Landerer treated them with alcohol, density 0·840, expelled the alcohol by distillation, and digested the residuum twice with a potash solution to dissolve the resin. The portion which resisted the potash was redissolved in alcohol, and the liquid left to spontaneous evaporation. The product, purified by the repeated action of animal charcoal and several crystallisations, possessed all the properties of piperine. M. Landerer admits, however, that this result needs confirmation.—*Wittstein Wiertejahr*, xi. 72.

PHYSICAL SCIENCE.

On the Spectra of Alkaline Metals, by MM. Wolf *and* Diacon.

In a paper published in the *Revue de Sociétés Savantes* (July 4, 1862), we have already stated that the light emitted by sodium at a high temperature is not monochromatic, but gives a spectrum of several well-defined rays. Some modifications in the methods we have hitherto used, suggested to us by M. Foucault, have enabled us to obtain this spectrum, as well as those of other alkaline metals, with far greater definiteness, and also to observe other rays not yet described.

On passing a hydrogen current through a slightly bent tube containing a volatile body in the lower part of the bend, the gaseous jet, escaping at the open extremity, is charged with the vapours of this body, increasing in quantity with the increased heat applied to the tube. By igniting the hydrogen, a coloured flame is produced, which, in some instances, becomes dazzling when the combustion is stimulated by a jet of pure oxygen. Many metallic chlorides, but especially alkaline metals and their volatile compounds, produce, under these conditions, perfectly distinct and very lasting spectra, by placing in the tube a sufficient quantity of material.

A globule of sodium, heated in this way in an iron tube, gives an intensely bright jet, in the spectrum of which appear six well defined rays, in the following position:—

δ.	α.	β.	ε.	γ.	δ.
105·7	100	95	80	74	60·7

The order of the Greek letters is that of the relative intensity of these lines. All are clearly marked on a

slightly coloured ground, extending nearly from 110 to 35.* This ground, however, is not continuous, but has two sudden variations in intensity,—one at 90, the other at 85. The first of these limits is remarkable for its correspondence with a green line, which we first perceived in the flame of sodium vapour burning in the air or in chlorine, and under no other circumstances. Its appearance seems to depend on the existence of an excess of sodium vapours: by raising the temperature of the iron tube, so as to increase the quantity of metallic vapour carried off by the hydrogen, the green band makes its appearance, limited by a very fine line, at 90 (and, consequently, between β of calcium and δ of barium); and, at the same time, is observed the effect remarked by M. Fizeau, the reversing of the brilliant ray α, due to the sodic vapours surrounding the flame.

Potassium, slightly heated under the same conditions, gives a magnificent flame, which can easily be maintained for a long time by the successive addition of metallic globules. The rays composing the spectrum of this metal have, for the most part, been described already by MM. Grandeau and Debray; they occupy the following positions:—

α.	γ.	δ.
125·5	117·5	98·5-97·8-97·5

ϵ.	ϵ.	ϵ.
87-86·5-86	79·5-79-78·5	74-73·3-72·5

ζ.	ζ.	ζ.	η.	β.
69	66·7	65	59·7	21·5

When potassium and sodium are introduced together into the tube, the spectrum of the potassium at first appears alone; but as it fades the sodium rays appear with growing intensity. By observing the two spectra thus superposed, it is easy to decide on the relative position of the rays of the two metals. It is thus we have decided that the blue lines, δ of sodium and η of potassium, in no way coincide.†

We had at our disposal no metallic lithium; but the same method, applied to the chlorides of the preceding metals, having given very clear spectra, though not so brilliant as with isolated metals, we were enabled to replace this metal by one of its volatile compounds. Instead of the iron tube, we used a small tube formed of platinum plate rolled round on itself; by heating in it pure chloride of lithium, we immediately obtained four characteristic and very brilliant lines:

α.	β.	δ.	γ.
114·3	104·3	73·2	57·2

The blue line γ, already noticed, corresponds almost exactly with the faintest of the two blue cæsium lines, as we have proved by means of chloride of lithium containing cæsium and rubidium. The absence of the most brilliant blue line of cæsium, the secondary sodium lines, and the red strontium lines, shows that the lines δ and γ belong specially to lithium.

The numerous experiments we have made on these various bodies, and particularly on sodium, have yielded identical results, whatever method was employed to volatilise either the metal or one of its compounds. By using sodium as electrode in Ruhmkorff's induction apparatus, the sparks exhibit all the above-mentioned rays, on which is superposed the spectrum of ambient gas, whenever the spark is accompanied by a luminous atmosphere.

Volatilisation in a hydrogen current seems to be applicable generally. It has been successfully applied to chloride of calcium; and though with chloride of strontium and barium, which are not sufficiently volatile, the results are not superior to those obtained by the ordinary method, it is very successful with the chlorides of copper, zinc, &c., which give us spectra so distinct and intense as to render the study of them exceedingly easy. It remains only to add that, with certain bodies, this light is so brilliant, that it may be advantageously employed for the projection of the phenomena.—*Comptes-Rendus.*

* These measures were obtained by superposing the image of a divided micrometer, or the spectrum given by a flint prism. The following will serve as terms of comparison and the position of the principal solar rays in the same apparatus:

A.	a.	B.	C.	D.	E.	b.	F.	G.	h.	H.
125·5	120·3	116·8	112·3	100	84·3	81	69·7	41·7	27	16·5

† Sodium and potassium give the same spectrum in a glass tube as in one of iron, with this difference, that it is accompanied by the principal rays of the other metal, furnished by the glass.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

November 4, 1862.

Professor A. W. Hofmann, *LL.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following gentlemen were balloted for, and duly elected Fellows of the Society:—Mr. William Gossage, of Warrington; Mr. Thomas Farmer Hall; Mr. George F. Rodwell; Mr. James Richards; Mr. W. H. Michael; Mr. Magnus M. Tate; Mr. John Chapman Wilson; and Mr. G. W. Septimus Piesse. Mr. John Henry Baldock was unanimously elected an Associate of the Society.

A paper was read by Mr. Church, entitled "*Notes on some Processes of Rock-Formation now in Action.*" The author described in abstract his experiments and observations on certain cases where sea-sand is consolidated into rock by the infiltration of fresh water. His analyses of the sand, before and after solidification, led him to conclude that the fresh water acted in re-arranging some of the constituents of the sand, notably the carbonate of calcium, rather than in adding fresh cementing material. He further illustrated his point by referring to the artificial formation of the singular siliceous mineral, Beekite. After various notices of the rapid deposit of travertine in various parts of the country, the author described the continued formation of the geodes of iron ore containing ochre found on Shotover Hill, near Oxford; of deposits of magnesian limestone in the same neighbourhood; of the siliceous and aluminous minerals, allophane and collyrite, and the siliceous concretions, found in the chalk; and of the calcareous nodules found in the London clay, and in other chemically-similar beds. Mr. Church pointed out how the compounds which existed in but small proportion in certain strata were often gradually separated, seemingly by the aid of water and carbonic acid, from the general mass, which was thus accordingly left often nearly definite in composition; the formation of metallic veins indicating similar agency.

Mr. Spiller remarked, in reference to what had just been stated by Mr. Church regarding the occurrence of sulphate of baryta and other crystalline aggregations in the centre of the septaria nodules found in the London clay, that a very similar illustration was afforded by the balls of clay ironstone occurring in the coal measures, which, on breaking open, often presented, in addition to sulphate of baryta, very curious and well-defined crystallisations of metallic sulphides, especially those of lead, copper, zinc, and nickel. These were generally discovered in the very centre of the nodule, forming as it were a kind of nucleus, around which the iron ore was deposited in a state of purity as regards impregnation with these metals. Some remarkable illustrations of this character were

exhibited in the mineral collections of the Royal School of Mines.

Dr. Williamson had often been perplexed with inquiries as to the natural origin of the brown sulphate of baryta in a stalactitic form, which from its structure appeared to have been deposited from solution. So far as he was aware, no satisfactory explanation had yet been adduced to account for these mineral formations.

Mr. Smee was anxious to hear, if possible, an account of the mode of formation of flints in the chalk.

Mr. Church considered there was evidence which tended to show that the origin of flints could be traced to water holding silica in solution. During the percolation of such water through the beds of chalk, the silica became separated at the same time that the carbonate of lime entered into solution. An interesting example might be mentioned of the deposition of silica in the form of chalcedony, occurring within a comparatively recent and brief period. Not further back probably than the year 1400, a basket of eggs was left in a chalk pit near Winchester, which was recovered again only lately by the removal of the broken chalk which had covered it so long, when it was found that the organic matter and the calcareous shell had entirely disappeared, their places being occupied by the semi-transparent variety of hydrated silica, known as chalcedony, which seemed further to have been deposited upon the willow twigs composing the basket, incrusting it so well that the real nature of the latter was evident to this day.

Mr. Smee referred to the solidity acquired by a mixture of lime and chalk when made into a kind of mortar, and allowed to set. Such materials could be moulded, and, when allowed to dry, became hard and solid, much closer in texture than common bricks, which, it was expected, would be partially superseded by the new calcareous blocks. He could not at the present moment enter into further particulars, inasmuch as a patent was being secured for the invention.

Dr. Williamson said it should be borne in mind that many samples of quick-lime, employed by builders, contained a very appreciable amount of soluble silica, and that, in estimating the value of mixtures of lime and chalk as substitutes for cement, this fact should be properly taken into account.

Dr. Edward Nicholson mentioned the circumstance of iron slag thrown out upon the sea-beach, having the property of agglutinating to itself the particles of sand by which it was surrounded—an effect due, he supposed, to the action of the calcareous salts of the sea upon the metallic sulphides and oxides in the iron slag.

Mr. Riley preferred to explain this agglutination, by attributing to the granules of metallic iron diffused throughout the slag the property of cementing together the particles of sand by virtue of the products of oxidation.

Dr. Woods communicated the substance of a paper presented to the Society, upon the "*Determination of the Amount of Organic Matter in Drinking Waters.*" The duty of a medical man consisted, in his estimation, as much in taking means to preserve health as in curing disease, and with this object in view he considered it highly important to pay attention to the character of the water supply, as influencing to a great extent the health of the community. Foremost among the impurities which were acknowledged to be prejudicial in water, the author ranked organic matter, particularly the products derived from the waste of the animal organism. It was to the quantitative determination of this constituent that his experiments had been directed, and to find a rapid mode of analysis—the desideratum. The method proposed was based upon the reducing action exerted by the organic matters dissolved in the water upon the permanganate of potash employed as a standard solution. Several trials were made, in order to ascertain the variations, by working at different temperatures, and with varying proportions of free acid. It was found, as a rule, that the same sample of water required twice the quantity of the permanganate solution at an elevated temperature (140° Fahrenheit) that was necessary when cold; and that time, more than the amount of free acid, was an element to be taken account of in the experiment. Dr. Woods recommended the following process:—A litre of water was mixed with a decided excess of pure sulphuric acid, and warmed, in a porcelain basin, to the temperature of 140° Fahrenheit; the solution of permanganate was then added, drop by drop, from the burette, until a slight pink tinge was permanent for half-an-hour. The "chameleon solution" contained one milligramme of crystallised permanganate in a cubic centimetre of distilled water; with this strength the water supplied to Chatham required from 2·4 to 7·5 c. c. to produce a permanent coloration. It was necessary to exclude the interfering influence of iron in the state of protoxide, so that when this constituent was present the water should be evaporated to dryness, the residue ignited, dissolved in sulphuric, and reduced by sulphurous acid, when the same standard solution would give the amount of iron, and a deduction made accordingly. Thus, in possession of a method of determining the amount of organic matter of a transitional nature, or reducing character, it became necessary to institute a standard of comparison, for it would be practically impossible in each instance to identify the kind of organic impurity. The author selected for his standard oxalic acid, and, with weighed quantities, he estimated the volume of permanganate required to destroy it; the results of analysis were stated, therefore, directly in accordance with this standard, and could at any future time be translated whenever the specific character of the organic matter present in any given sample should have been ascertained. The results had been compared also with the numbers afforded by the loss of weight on ignition, in order to furnish a means of comparison with the system ordinarily followed in the analysis of waters. Sewage water, and a sample drawn from a pump in the neighbourhood of a cesspool, had been tested by this method; the latter was found to contain five grains of organic matter (oxidisable) in the gallon. Pure urea was itself without action upon permanganate of potash, but in association with the other organic constituents of urine it exerted, likewise, a reducing property.

Dr. E. Nicholson submitted that the inorganic impurities of water were often the cause of its unwholesomeness, and that the amounts of the sulphates of magnesia and soda should be looked to equally with the organic matter. He held as tyrannical that article of faith which assumes all kinds of organic matter to be inherently deleterious.

Mr. Smee stated his opinion that, as a rule, all animal excreta must be considered injurious, or even poisonous, to animals of the same class; and it behoves chemists, who, in the capacity of manufacturers, were often guilty of contaminating the rivers and streams flowing past their works, to be especially watchful in regard to the introduction of organic impurities of a decomposable nature, for these were highly prejudicial to health, and had, no doubt, been the cause of much mischief during the prevalence of great outbreaks of zymotic disease. He referred to the well-known instances of bad water supply at the Milton Road, Wandsworth, and the pump water in Broad Street, Golden Square, as proof of the injury caused by the infiltration of sewage matters; and he thought the first duty of the medical man should consist in an examination of the water supply whenever low fever was the prevalent disorder in a household. He would remind even the Fellows of the Society who were residing at the west end of London, that they were often treated to the refuse which the Thames brought them from the aristocracy of Oxford. The water supply of Glasgow contained organic matter of a peaty nature, but this he held to be far less objectionable; it was known, indeed, that a *bouquet* would flourish in peaty

water, and survive much longer than in such as had been contaminated by the admixture of animal matters.

Mr. Chabot referred to the period when the water of the Thames was held in high estimation by the Navy, and, when taken on board, would last longer in good condition than many other kinds of water then available. It was remarked, that it used alternately to putrefy and become again sweet and fit to drink some two or three times on the voyage. Mr. Chabot had tasted water kept for six years in a tank, which was quite fresh and good, although it had passed through the stages of decomposition already mentioned.

Mr. Smee believed that the best water now to send on a voyage was that derived from deep springs in the chalk, which contained but an inappreciable amount of organic matter. The mineral salts in the water might sometimes counteract, for a time, the tendency to decomposition, and the charcoal filter effect some improvement, but eventually the organic impurity must make itself apparent. When the Croydon case came for judgment before the Vice-Chancellor, he remembered an attempt being made to prove the excellent quality of the water by producing in court a glass of water just drawn. In company with the President, he had, however, taken the precaution of collecting a sample from the same source a day or two earlier, and had merely to warm it, by placing the bottle on the mantelpiece, to develop the true history of the case.

Professor Redwood mentioned an apparent exception to the rule laid down by Mr. Smee in the observation, that horses and cattle seemed to prefer to drink the dirty water of a stagnant pond rather than go to a purer supply of river water, when both were equally within their reach.

Dr. Williamson considered the chief merit of the system of analysis just now brought before the Society to consist in the classification it attempted, as regards the division of organic matter into two separate kinds, for it was very important to distinguish the animal from that of vegetable origin.

Dr. Woods made good his assertion with respect to the prejudicial influence of organic impurities of animal origin when taken into the human system, by narrating the circumstance which induced him to adopt this view. A short time ago, two ships were despatched simultaneously with troops from Algeria to France, both under similar circumstances, excepting that the supply of water had been drawn, in one case, from the low marshy lands, where ague was prevalent, whilst the other ship had taken water from a locality situate at a greater elevation, and where the disease was unknown. The passengers on board the first transport were quickly seized with remittent fever, whereas no case of illness occurred on board the second vessel.

The third communication was by Mr. George F. Rodwell, on the "*Reactions of Sulphate and Sulphide of Lead with Hydrogen and Carbonic Oxide.*" When hydrogen was passed over dry sulphate of lead heated to redness it had usually been stated that water, sulphurous acid, and, ultimately, sulphuretted hydrogen, were formed, whilst a mixture of metallic lead and sulphide of lead remained in the tube. The author's experiments had, however, disproved this statement; for, as the result of the reaction, he had obtained definite crystals—cubes and octohedra—of sulphide of lead, water, and a trace only of sulphuric acid. It was so necessary to exclude the presence of air or oxygen, that the hydrogen gas was passed through the apparatus until it no longer showed any red fumes with binoxide of nitrogen. The action of carbonic oxide under similar circumstances was commonly, but erroneously, explained by the following equation:—

$$2PbOSO_3 + 6CO = PbS + Pb + SO_2 + 6CO_2.$$

In the preparation of pure sulphide of lead difficulties were met with, in consequence of the tendency of the precipitated sulphide to absorb oxygen from the air, and pass into the state of sulphide of lead; also on account of the metallic precipitate carrying down with it some acetic acid when prepared from the acetate. The process ultimately adopted was to obtain a crude sulphide by passing sulphuretted hydrogen through a solution of the nitrate of lead, to wash this thoroughly, then suspend it in water, and again pass sulphuretted hydrogen. The product, being rapidly collected, was dried in a current of the same gas, and finally heated in hydrogen to displace a small quantity of free sulphur always remaining in admixture. If, now, the temperature were raised to bright redness, and the current of hydrogen maintained, it was found that the sulphide of lead did not lose sulphur, but was merely converted into a hard grey mass; or if the tube had been heated to whiteness, the same substance fused, and even partially sublimed, without any chemical alteration, and afforded crystals on cooling. In similar experiments conducted in an atmosphere of pure carbonic oxide the results were essentially the same; the sulphide of lead lost, however, small proportions of sulphur varying from ·39 to 1·62 per cent., which were found to have been converted into bisulphide of carbon. In order to ensure the purity of carbonic oxide from admixture of oxygen, the gas was passed through a solution of pyrogallic acid in caustic potash. The heat of a four-jet Bunsen gas-burner was sometimes employed, but when a white heat was necessary a very convenient miniature furnace was improvised by inserting the bowl of a large Dutch tobacco-pipe into the lower part of a refractory clay crucible, and leading the stem through in order to furnish a means of injecting common air, and afterwards oxygen, to urge the combustion of the charcoal or other fuel in the crucible. Holes were bored on opposite sides near the top for the insertion of a porcelain or glass tube, according to the degree of heat about to be employed.

Dr. Thudichum gave an abstract of a paper on the "*Composition of Gall-stones in Man and Animals.*" The author referred to an earlier communication on the same subject, wherein he had demonstrated the general nature of bile, and it remained now to describe more minutely certain abnormal constituents which entered into the composition of biliary calculi. The mode of examination was to extract, in the first instance, all matters which were soluble in water, then to act upon the residue with hydrochloric acid, employing the solvent powers of ether and alcohol for the purpose of separating out certain bodies from among the complex series ordinarily occurring in gall-stones. The aqueous solution, when allowed to stand at rest, deposited some phosphate of lime in crystals of considerable dimensions. The hydrochloric extract soon became decomposed, exhaling an odour very similar to pickled onions, and due to the formation of a sulphur compound which had not yet been isolated. The most striking circumstance presented in this part of the examination was the occurrence of zinc, and the precipitation of the sulphide of that metal from a solution possessing an acid reaction. In enumerating the several substances detected in gall-stones, Dr. Thudichum mentioned the following:—Cholochrome, the colouring matter of bile, sometimes green, at other times brown; cholesterine; chlonic and glycocholic acids, the soda compound of a new resinous acid; the phosphates of soda, lime, and magnesia; the two latter bases also in the form of carbonates; oxide and phosphate of iron; alumina; zinc, in considerable quantity; traces of manganese and copper; and the chlorides of sodium and ammonium.

A vote of thanks having been passed to the authors of the several communications, the President adjourned the meeting until the 18th instant.

PHARMACEUTICAL SOCIETY.

Wednesday, December 3, 1862.

Mr. P. Squire, *President, in the Chair.*

(*Continued from page* 296.)

At the termination of the discussion reported last week,

Mr. Holmes not having arrived, Mr. Sargeant proceeded to read an abstract of the paper on "*Petroleum, or Earth-oil; its Origin, Discovery, Manufacture, and Commercial Value*," premising that the opinions expressed therein were to be considered as those of Mr. Holmes, and not as his own. As the readers of the Chemical News are well posted in all information relating to petroleum oils, it is necessary to give little more than the original speculations of Mr. Holmes as to the origin of these oils. Asserting at the outset that the oils are identical with the products of the distillation of coal, the author conjectures that they must have had an identical origin; that at some period or other in the earth's history the coal deposits of the new world must have been submitted to heat, and the products then formed and volatilised having mixed with, and been moved about by, the atmosphere, had condensed again, according to their gravities, had fallen as rain, and sunk once more into the earth; that vast floods had then swept immense deposits of earth over the spots on which they fell, and so hidden them from human ken until their recent discovery. As to the uses of the petroleum, Mr. Holmes informed us that benzole, and, consequently, aniline, and all its coloured derivatives, could be procured from it; that the crude oil preserves wood for all time; that the Indians bathe in it to heal wounds; that it may be burnt in locomotives to generate steam, cotton waste being placed on the furnace bars, and the oil dropped thereon by proper contrivances; that it is the cheapest known agent for the production of light; that, with care, the process of rectification is perfectly safe; that one of the products—benzine—is a perfect substitute for oil of turpentine in paints and varnishes; and that the heaviest oil is an excellent lubricator.

Professor Redwood said it was necessary to guard against incorrect impressions which might be formed on listening to the paper. Some of the statements made were at variance with the actual truth. If aniline, or a product from which aniline might be made, could be found in petroleum, it would be worth a hundred times more than it is; but chemists had examined it in vain for benzole; and of oils from which dyes could be made there was not a trace.

Mr. Williams called attention to the lightest produce obtained from petroleum by fractionnation—namely, kerosolene—a body which possessed an odour resembling that of amylene, and which, also, had been used with some success as an anæsthetic. He thought it a body which deserved more study and consideration than it had yet received.

Mr. Bottle enquired whether the oils after purification underwent any change—whether those which were not explosive become explosive after a lapse of time?

Mr. Sergeant said the rectified oils would keep any time without change.

Mr. Blane asked if any member had had any experience in the use of the oils for paints? He had been informed that they did not answer for this purpose; that when used with turpentine they separated from it; and that when used alone they were too volatile.

Mr. Sergeant said they were used in the United States with turpentine in equal parts with perfect success.

Professor Redwood then exhibited some ingenious models by Mr. Larkin, illustrating the derivation of crystalline forms. They are more simple and cheaper than any Mr. Larkin has hitherto made.

Mr. D. Hanbury, Jun., exhibited some "Insect Powder" from the great Exhibition, which had been presented to the Museum. It was brought from Tiflis, in Georgia, and consisted of the powdered flowers of the *Pyrethrium roseum*, a plant which was not poisonous to man, but which was extremely noxious to insects. It was used all over the East to destroy fleas and bugs, and might be used with advantage here to destroy the blight on rose trees.

A Member enquired where genuine potash alum could be procured? He had found that all the specimens of alum he had examined contained ammonia, and thought this of some importance when the alum was used for making the Alumen exsiccatum of the Pharmacopœia.

Mr. D. Hanbury, Jun., said, that in the Jurors' report of Class 2, Section B, it was stated that in almost all instances the alums exhibited contained ammonia. Samples in which it was absent had, however, been received from Italy, Spain, and Trieste.

Professor Redwood remarked that the Whitby slate, from which most of our alum was made, contained some potash, and formerly the quantity of alkali required was made up by the addition of more potash, but now ammonia, which is much cheaper, is used instead. He believed that in the Pharmacopœia process for the preparation of Alumen exsiccatum, the greater part of the sulphate of ammonia must be driven off.

Dr. Attfield exhibited a specimen of magnesite which had been presented to the Society by the Messrs Jamble, and remarked that such specimens were of great value where students were engaged in the study of pharmaceutical chemistry, as it enabled them to start with the raw material of the salt they wished to produce, just as it would be presented to them in actual practice.

The meeting then adjourned.

NOTICES OF BOOKS.

An Antidote to the Sanitary Evils of Cities and Towns, in the Patent Eureka System, by which the Contents of Privies, Ash-pits, &c., become the great Fertilisers of the Soil. Manchester: Published by the Patent Eureka Sanitary and Manure Company.

Just as we are perfecting, at an enormous outlay, our system of drainage, people are coming to the conclusion, that the vast expenditure of money is but a wasteful means of accomplishing a wasteful end; and by the time the outfall works at Erith are completed, we have little doubt that the Board of Works will be seriously occupied with schemes for a return to the "cesspool system." Believing, as we do, that liquid sewage—at all events, London sewage—would be to the farmer, in most instances, only "a mockery, a delusion, and a snare," we should hail with satisfaction any scheme which effectually provided for the preservation of human excreta in an undiluted state, without any contamination of the atmosphere of human dwellings. A plan is in use in Manchester by which this is said to be accomplished. How far it would be successful in avoiding any nuisance in houses we cannot say, but the inoffensive nature of the works at which the matters are prepared for agricultural purposes are certified by Dr. Roscoe and other chemists and sanitarians. The arrangements of the closets, where the system is adopted, is described as follows:—

"Beneath the seat of the closet, instead of a cesspool or drain, as under the old system, a movable box for the reception of the deposits is placed, constructed to receive a closely-fitting lid. All the boxes and all the lids are of uniform sizes. When it is considered desirable to remove the contents, a lid is taken from an empty box and inserted in a full one. The full box is then removed bodily and placed in a covered van, whence the empty one has just been taken. The empty one is then introduced under the seat; the whole being the work of little more than a moment. Each box is subjected to the process for deodorising its future contents before being placed in the closet. Boxes for the reception of the ashes are provided in like manner. These are removed separately, and in neither case can the process of removal possibly prove offensive in any way.

"Dr. Roscoe (Professor of Chemistry at Owen's College), one of the deputation appointed by the Manchester and Salford Sanitary Association to visit the Eureka Works,

at Hyde, stated in his report that 'the process seemed to be a most important and interesting one in a sanitary point of view.' After describing the process, he remarked that '*no unpleasant smell whatever* was noticed in the petties, and it was instructive to see the difference beween the back premises under the new and the old systems, where the putrid matter was allowed to be for months, and was then turned into the streets previous to removal. The unanimous opinion of the inhabitants of these cottages was in favour of the new plan, which removed perfectly the nuisances from which they formerly suffered. The process of *removal* and *manufacture is free from all nuisance*, as might be judged from the fact, that it was carried out on a large scale, in the middle of a densely-populated district.'"

As the pamphlet noticed is little more than the prospectus of a private company, and as other opportunities of discussing the subject will soon arise, we can only say that the plan is a meritorious attempt at the solution of a great public question.

NOTICES OF PATENTS.

2441. *The Preparation and Application of Certain New Hemostatic and Antiseptic Agents.* P. A. Boboeuf, Paris. Dated September 30, 1861.

For the manufacture of a chemical agent, which may be usefully employed as an antiseptic and as a remedy in cases of hæmorrhage, the patentee combines carbolic or phenic acid with caustic potash or soda, whereby he obtains a kind of saline compound, possessing properties which render it particularly suitable for application in the manner described. The inventor claims likewise the employment of other essential oils, which are soluble in alkali, particularly those derived from coal, peat, and wood (creosote especially), and which may be shown to act in a similar manner.

2456. *Starch.* W. Maltby, De Crespigny Park, Camberwell. Dated October 2, 1861.

In the preparation of starch from rice, the inventor submits the ground rice to successive treatments in a vat with a false bottom, with a dilute solution of alkali, and alternately washes the product with water and alkali until the washings are no longer coloured. The starch, being drained, is then treated with solution of alum, or of bisulphate of potash, or with any salt of a metallic or earthy base which will have the effect of producing a white precipitate on the addition of an alkali, until the starch becomes white, and the free alkali is neutralised. The product is then washed thoroughly, dried, and ground to the state of fine powder for use. The second part of the invention relates to the method adopted in treating starch, rice, wheaten flour, or any other substance containing starch, for the purpose of rendering it more gummy and soluble, and capable of producing a superior glaze. For every thirty-two pounds' weight of either of these substances, the inventor takes from one to four pounds of ground malt, or, in larger proportion, even the husks from the same, with sufficient water only to obtain a solution of the diastase. This liquid, being then intimately mixed with the starch, is set aside for some time in a warm place; the mass is then dried, and finally ground for use. The colour of this preparation may be improved by treating the solution of diastase with precipitated alumina prior to its employment.

This last operation is manifestly carried out for the purpose of converting a small portion of the starch into dextrine; the instructions given are, therefore, well adapted to the object in view, and would produce a commercial article of undoubted excellence.

Grants of Provisional Protection for Six Months.

2197. James Higgin, Manchester, "An improved substitute for cow dung used in printing and dyeing textile fabrics or yarns."—Petition recorded August 5, 1862.

2393. Charles Humfrey, Suffolk Grove, Southwark, Surrey, "Improvements in the treatment of petroleum to render it non-inflammable."—Petitions recorded August 28, 1268.

2421. William Clark, Chancery Lane, London, "Improvements in the means of obtaining light and heat, and in apparatus for the same."—A communication from M. Marin Joseph Alphonse Mille, Boulevart St. Martin, Paris.

2443. Peter John Bossard, Kennington Road, Surrey, "Improvements in stoppers for bottles, jars, guns, tubes, and other open-mouthed articles, in taps, and in fixing them in casks and other vessels."—A communication from Louis Alexandre Farjon, Paris.—Petitions recorded September 3, 1862.

2458. Sidney Hopton Hadley, City Mills, Upper Thames Street, London, "An improved process for manufacturing gas for illumination."

2459. John Robert Johnson, Stanbrook Cottage, Hammersmith, Middlesex, and John Ashworth Harrison, St. Andrew's Road, Southwark, Surrey, "Improvements in apparatus for taking photographic panoramic pictures."—Petitions recorded September 5, 1862.

2461. Jacob Snider, jun., Dorset Street, London, "A new and useful method of increasing the durability of, and for preserving cloths and other like fabrics used for sails, tarpaulins, tents, and other coverings; also all kinds of ropes, and cables, and telegraph-wires; also all woods and metals, and other materials used in buildings or constructions on land or on water; and all objects exposed to the action of acids, alkalies, gases, fire, fresh or salt water, atmospheric or other like destructive influences, by the application of graphite."

2462. Samuel Pudney, Manor Street, Clapham, Surrey, "Improvements in apparatus to be used in the manufacture of sulphuric acid."

2483. Theodor Fleitmann, Iserlohn, Prussia, "Improvements in the manufacture of copper from copper ores."—Petitions recorded September 9, 1862.

2491. George Ritchie, Edinburgh, Mid Lothian, N.B., "Improvements in extracting the liquid portion of yeast, spent hops, or other similar matters, and in the apparatus employed therein."

2100. James Leetch, St. Marylebone, and Brownlow Mathew, St. James's, London, "New and improved methods of protecting the surfaces of iron or other metal work from oxidation, incrustations, or accumulations of any kind, more especially in the cases of ships' bottoms, steam-boilers, and machinery."—Petition recorded July 24, 1862.

3080. Henry Bennett Whitburn, Orrell Colliery, Lancashire, "An improved method of purifying sand to be used in the manufacture of glass, and for other purposes where silica is used."—Petitions recorded November 15, 1862.

3132. Thomas Walker, Birmingham, "Improvements in utilising sewage matters, and in the means or apparatus employed therein, part of which improvements is also applicable to raising and forcing other fluids."

3134. Robert Walter Swinburne, South Shields, Durham, "Improvements in the manufacture of soda."

3178. Frederic William Hartley, Millbank Street, Westminster, "Improved means of obtaining certain products resulting from the manufacture and purification of coal gas."—A communication from George Huwitz, Copenhagen, Denmark.

3184. William Clark, Chancery Lane, London, "Improvements in the preservation of animal and vegetable substances."—A communication from Henri De Lapparent, Boulevart St. Martin, Paris.—Petitions recorded November 27, 1862.

3100. Nathan Thompson, Abbey Gardens, St. John's Wood, London, "Improvements in apparatus for stopping bottles, jars, and other vessels."

Notices to Proceed.

1440. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the purification of colza, rape, and other oils."—A communication from Charles Henri Michaud, Paris.

1475. Isham Baggs, Cambridge Terrace, Middlesex, and William Simpson, Tovil Upper Mills, Maidstone, Kent, "Improvements in treating straw, Spanish grass, and other vegetable fibres, in preparing a bleaching agent for vegetable fibres, and in recovering and treating an alkali resulting from the treatment of the said fibres, and in apparatuses employed therein."

1533. Macedo Alexandre le Brun Virloy, Rue Pigalle, Paris, "Improvements in drying and carbonising wood, peat, and other fuel."

2380. William Edward Newton, Chancery Lane, London, "An improved method of producing light for the various purposes of artificial illumination."—A communication from George Hand Smith, Rochester, Monroe, New York, United States.—Petitions recorded August 27, 1862.

2100. James Leetch, Marylebone, and Brownlow Mathew, St. James's, London, "New and improved methods of protecting the surfaces of iron or other metal work from oxidation, incrustations, or accumulations of any kind, more especially in the cases of ships' bottoms, steam-boilers, and machinery.—Petition recorded July 24, 1862.

2148. Edward Thomas Hughes, Chancery Lane, London, "An improved process of refining the slag from blast, puddling, and other furnaces, and the employment of the refined material for mortar, stones, slabs, ornaments, and other similar articles." A communication from Emil Langen, Siegburg, Prussia.

2164. George Henry Birkbeck, Southampton Buildings, Chancery Lane, London, "Improvements in the means or processes employed for preserving timber from decay or destruction."—A communication from George Huwitz, Copenhagen, Denmark.—Petitions recorded July 30, 1862.

2275. Louis Desire Verstraet and Etienne Maurice Olivier, Boulevart St. Martin, Paris, "A new process of manufacturing carbonate of soda by the application of sulphuret of sodium, and in apparatus for the same."—Petition recorded August 13, 1862.

2477. John Webster, Woodbridge Road, Ipswich, Suffolk, "Improvements in preventing the incrustation of steam-boilers."—Petition recorded September 9, 1862.

2887. Frederick Lipscombe, Strand, London, "Improvements in purifying water."—Petition recorded October 27, 1862.

2904. Charles Stewart Duncan, Inverness Road, Bayswater, London, "An improved compound or material for coating or covering metallic and vegetable substances to preserve them from corrosion or decay."—Petition recorded October 28, 1862.

3044. George Smith, Phœnix Chemical Works, Cobden Street, Stewart's Lane, Battersea, Surrey, "Certain improvements in obtaining colouring matter."—Petition recorded November 12, 1862.

Patents on which the Stamp Duty of 50l. has been Paid.

2717. Charles Antoine Fournier, Boulevart de Strasbourg, Paris, "A process and apparatuses intended to find out the escapes of lighting gas from the conveying pipes, and to determine the precise leaking places of the said pipes."—Dated December 1, 1859.

2789. John Macintosh, North Bank, Regent's Park, London, "Improvements in the manufacture of waterproof and other fabrics, and of moulded or formed articles."—Dated December 8, 1859.

CORRESPONDENCE.

Webster's Process for Making Oxygen.

To the Editor of the Chemical News.

Sir,—"A Chemist" in your last Number says 158 cubic feet of oxygen agrees with 13 lbs. evaporated out of the retort, but he has omitted to notice that Mr. Campbell got from 4 to 6½ lbs. condensed in the purifier, or part of the 13 lbs. However, this is no answer to the matter stated in my letter, and no other has attempted to give an explanation: indeed, I scarcely did expect one, because I believe it is impossible to explain to your chemical readers how, on decomposing 30 lbs. nitrate of soda by heat, there could be produced a quantity of soda equivalent to 37 lbs. nitrate, and, while the condensation of the whole of the nitric acid took place in the purifier, it at the same time could become decomposed into 158 cubic feet of oxygen and nitrogen gases: these are the facts stated to have been got in several experiments. Moreover, if your readers will turn to the paper printed in your journal of November 29, they will find it given out that a charge in the purifier, by gaining from 4 to 6½ lbs., reacquired all the nitric acid it lost in the retort; the water in the purifier contained, Mr. Campbell says, acid to neutralise any carbonate of soda. The whole of the soda was, therefore, reconverted into nitrate by gaining less than one-half the weight it lost. I take it for granted, that if a dry salt loses a part of its constituents, it must regain this part to make it what it was; but Mr. Campbell's 30 lbs. loses 13 lbs., and a condensation of from 4 lbs. to 6½ lbs. makes it into nitrate again!

The composition of the residue in the retort is—

Sand, with oxide of iron . .	13·66 or =	5·1
Oxide of zinc	30·20 =	11·1
Anhydrous soda . . .	24·80 =	9·2
Nitrite of soda, with a little nitrate	31·34 =	11·6
	100 parts or	37 lbs.

With such result, the loss in the retort must have been very much greater than 13 lbs.

9·2 anhydrous soda	= 24·7 nitrate =	15·5 loss	
11·6 nitrite	,, = 12·7 ,, =	1·1	,,
20 oxide zinc used, and 11·1 got	=	8·9	,,
		25·5	,,
Deduct the gain of sand, oxide iron	=	5·1	,,
		20·4 lbs.	

must have been the loss from the per-centage composition given of the residue.

At this rate, it will take me some time to wade through this report, and show your readers a few more of the absurdities it contains. It is the most suggestive paper I have ever read; and few could have believed that such inconsistencies would have been advanced by a chemist for the purpose of proving the value of a patent.

Messrs. John H. Porter and Co., in justice to themselves, should, without delay, produce better proof of the value of the patent they hold for making oxygen, and they should explain to your readers how they gave out an inexplicable report of this kind. If they saw Mr. Campbell do the experiments, they will, perhaps, gratify your readers with a probable explanation of how the irreconcilable points I have mentioned could have arisen.

Failing any explanation, I shall, with your kind permission, go on with my examination of the report in future Numbers of your journal.—I am, &c.

An Inquirer.

Alkali Waste.

To the Editor of the Chemical News.

Sir,—My attention has been drawn to a correspondence in your journal, on the subject of "alkali waste;" and

although I appear late in the field, I hope I shall not be deprived of the gratification of adding my testimony to that of others, in favour of the views which Mr. Gossage long ago propounded, and consistently holds to this day, which demonstrably show the true and simple composition of the alkali waste.

In the beginning of the year 1838, I had the good fortune to be employed by Mr. Gossage to work out his then recently patented processes for the condensation of hydrochloric acid; and also the elimination of sulphur and carbonate of lime from alkali waste. I believe I am within the mark, when I say, that I made more than a hundred—if not hundreds of—experiments, under his personal supervision, all founded on the theory, which he then laid down for my guidance, that the waste was simply a combination of sulphur and calcium, in simple equivalents.

Since the period referred to, I have been continuously engaged in the manufacture of alkali on a large scale, and have not met with any anomalous circumstance in that time to shake my confidence in the truth of the theory Mr. Gossage then propounded.

But I think, if any further proof of the truth of this view of the subject were wanting, it is to be found in the fact, that in our own manufactory Mr. Arrott has decomposed large quantities of sulphate of soda, with small coal and one equivalent of lime ($CaOCO_2$), as perfectly as in the ordinary way; and the remaining sulphide of calcium, after lixiviation, was identical in its character and appearance with that made in the usual way—oxide of calcium, or its carbonate, being absent.

I have read also Mr. Decon's remarks on the oxidability of the many compounds of sulphur and calcium, and I most heartily coincide with his views on this subject.

Your insertion of the above remarks in your next publication will greatly oblige. I am, &c.

James Shanks.

St. Helen's, Lancashire.

Double Equivalents.

To the Editor of the Chemical News.

Sir,—Allow us, as chemists of many years' standing, to express in your wide-spread columns the regret we feel at seeing the extension taken of late years by a pernicious and false doctrine which we, and doubtless many others, consider highly prejudicial to the advance of chemistry. We allude to the unjustifiable manner in which certain of our brother labourers have endeavoured to introduce the system of doubling the equivalents of oxygen and carbon, for the sake, merely, of being able to explain, in a one-sided manner, the relations and reactions of organic compounds. The absurd notion of cramming every organic compound into the formula of water or ammonia is so preposterous, that it is not surprising to see it already abandoned by many who once adhered to it.

But to return to the doubling of the equivalents of oxygen and carbon, we defy any chemist to show the slightest advantage to be gained thereby, or to refute the following simple facts which are directly opposed to it:—

The equivalent of hydrogen being taken = 1, we observe that when hydrogen and oxygen unite to form water, 1 lb. of H unites with 8 lbs. of O, and, therefore, 1 being the equivalent of H, 8 must naturally be the equivalent of O. If we take volumes, we find 2 vols. of H combine with 1 vol. of O; here, also, the 2 vols. of H weigh 1 lb., whilst the 1 vol. of O weighs 8 lbs. The vapour of water thus formed equals 2 vols.; and if (to establish a similarity between this vapour and organic vapours) we make these 2 vols. equal to 4 vols., we have evidently, in these 4 vols., 2 equivalents of O = 16, and 2 equivalents of H = 2. If, therefore, we double the equivalent of oxygen, we must also double that of hydrogen, and, consequently, the equivalents of all the elements without exception. It is evidently more simple to double nothing at all! If we wish to represent 4 vols. of water, can it not be done by writing H_2O_2? But, Sir, upon what authority can we write aniline = C_6H_7N, when we know that $C_{12}H_7N$ is its proper formula, and will alone serve to calculate its composition? Upon what authority can we represent 2 equivalents of carbonic acid by CO_2, when they demand 2 CO_2 or C_2O_4? It is evident, Sir, that we have no authority whatever for so doing, and that this system of doubling is, to say the least, a mere humbug. Where error has taken root, there is no knowing how long it may flourish in the shade of one-sided views. The *chaos* called "Organic Chemistry" in the present day is simply owing to liberties like those alluded to in this letter have been tolerated in the hope of promoting science; but have they helped to promote or to complicate it? We leave this question to the unprejudiced of your numerous readers, and beg to remain, &c. F.R.S. and F.C.S.

London, December 11.

Black Dye from Aniline.

To the Editor of the Chemical News.

Sir,—Having seen a notice of a new black from aniline in a recent number of the Chemical News, I would state, that some time ago I obtained on cotton fabric a black from aniline, capable of resisting acids, alkalies, and other re-agents to a very remarkable extent, and which was very difficult to discharge.—I am, &c.

W. Cort Wright.

Laboratory, Bank Bridge, near Manchester.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Reduction of Sulphuric Acid to the State of Sulphuretted Hydrogen by Nascent Hydrogen.—Kolbe points out (*Annal. der Chem. und Pharm.*, bd. cxix. s. 174), that when strong sulphuric acid is used for the production of hydrogen, the gas is always contaminated with some sulphuretted hydrogen, the more the stronger the acid in contact with the zinc is: when the acid is diluted with twice its volume of water, no sulphuretted hydrogen is evolved.

Iodide of Sulphur.—By the slow evaporation of a solution of sulphur and iodine in sulphide of carbon, Lamers states (*Journal für Prakt. Chem.*, bd. lxxxiv. s. 349), that crystals are formed which, having the colour and form of iodine, nevertheless contain sulphur. He analysed them, and obtained results which nearly agreed with the formula SI_3. When exposed to the air, the iodine evaporated and left a skeleton crystal of sulphur of the original form. The composition of the crystals obtained was found to be constant.

Atomic Weight of Silicium.—Schiff has determined (*Annal. der Chem. und Pharm.*, bd. cxx. s. 94) the atomic weight of silicium by breaking small bottles of the chloride in water rendered slightly ammoniacal, allowing the solution to remain for some days, then boiling, filtering, and estimating the chlorine. Two determinations gave as a mean 28·01 for the silicium, admitting the chloride to be $SiCl_4$.

II. ORGANIC CHEMISTRY.

Ditartaric and Disuccinic Acids.—When tartaric acid is kept for some time in a state of fusion, it loses, says H. Schiff (*Comptes Rendus*, t. liv. p. 1075), half a molecule of water without becoming coloured, and is changed into an acid containing two equivalents of the tartaric radical in one molecule. Ditartaric acid does not crystallise: it forms salts very soluble in water and precipitable by alcohol in a syrupy form, or in voluminous flocculi, which, on agitation, become a mass. The ditartrates, and even di-

tartaric ether, may be formed directly by combining tartrates with anhydrous tartaric acid.

Succinic acid, in subliming, also loses half a molecule of water, and is changed into disuccinic acid. According to the author, ditartaric acid is identical with the isotartaric acid of Laurent and Gerhardt, and, mixed with metatartaric acid, forms, without doubt, the tartrelic acid of Frémy.

MISCELLANEOUS.

CAUTION TO PETROLEUM REFINERS.

It is well known that one of the most objectionable impurities in coal gas is bisulphide of carbon, which, upon combustion, yields sulphurous acid—a gas particularly detrimental to pictures, bindings of books, art decorations, and even to delicate constitutions. Numberless have been the expedients resorted to with a view to get rid of this noxious impurity, and latterly with some degree of success. Nevertheless, the formation of sulphurous acid by the combustion of sulphur compounds in coal gas, has precluded its use in many public libraries, picture galleries, and in private dwellings.

It is much to be regretted that the rock oil furnished by some refining companies contains a notable quantity of sulphur, either in the form of sulphuretted hydro-carbons or sulphuric acid. These impurities generally arise from a neglect on the part of the refiner to remove the whole of the sulphuric acid he employs in his refining process. It is of the highest importance that the sulphuric acid should be abstracted as far as possible; and, although we do not say that during the process of refining some sulphuretted hydro-carbons may be produced which, in the present state of our knowledge, it would be impossible wholly to remove, yet from actual experiment we have detected the presence of sulphuric acid in some samples of rock oil, showing that this acid was not wholly withdrawn by the after use of alkalies, washing, or other expedients. It is essentially important, in order to produce a good sample of refined rock oil, that the whole of the sulphuric acid should be abstracted; otherwise, during combustion, sulphurous acid will be generated, and a noxious compound, very insidious and prejudicial in its effects, will be generated, in greater or less quantities, by the use of rock oil. Refiners should satisfy themselves by chemical tests that every trace of sulphuric acid is removed from their samples of oil, before permitting them to go to market. Neglect in this important particular may soon engender a distaste for a beautiful and most economical mode of illumination, rendered prejudicial by inattention to simple precautions in refining, which a desire to produce a safe and saleable article ought to ensure. A piece of white blotting-paper moistened with a solution of iodic acid and starch, held over the flame of a rock oil lamp, will become bluish purple, if sulphurous acid is generated during the process of combustion. This test, however, is not sufficient, as there may be other deoxidising agents in the gases, resulting from combustion, which would set iodine free. The samples of rock oil may be tested with a solution of chloride of barium. If the sulphuric acid has not been wholly removed, a heavy white precipitate will indicate its presence. We would recommend refiners always to test their oil after the washing process is completed, to see if the last traces of sulphuric acid have been withdrawn. In some instances which have come under our notice, a very marked reaction took place when tested with chloride of barium, as well as decided indications of sulphurous acid in the products of combustion, when a slip of paper, moistened with a solution of iodic acid and starch, was held over the chimney of the lamp.

Dangers of Distilling Petroleum.—Some time ago, Messrs. Charles and Maxwell, of Saltness, near Chester, began the distillation of Canadian rock oil, and not knowing that this was more dangerous than the oil they formerly distilled, took no particular precautions to guard against accident. On one occasion, however, the vapour having escaped from some crude oil spilled about, it became mixed with the air of the still-house, and was fired when a workman entered the house with a light. The roof was blown off, and the whole factory burned down.

Royal Institution.—On Saturday, December 27, at three o'clock, Professor Frankland, F.R.S., will deliver a juvenile lecture on "Air and Water."

Menhaden Oil.—In the Peconic Bay there are no less than six manufactories, consuming, in the aggregate, about 2,000,000 fish weekly. The fish are caught in Gardiner's Bay mostly, where they abound in great quantities. They are taken by what we call purse seines, and can be caught in any depth of water. The seine is made (as its name indicates) like an old-fashioned purse; after rowing around the fish the bottom is closed by a purse line, and the fish are secure. There are four companies of fishermen from Rhode Island here at this time, having from four to five large boats apiece, and from eight to nine men. The fish are bought for $1 per thousand. These seines some days catch 150,000 each, which you see makes a paying business of it. The manufactories are nearly all on different plans. Some use large tanks, in which the fish are placed, and into which steam is forced. A portion of the oil is extracted, coming on the surface of the water, and is skimmed off; the water is then drained off, and the refuse is pressed by hydraulic presses or powerful levers. In another way of working, used by one manufactory, the fish are placed in a large iron cylinder, similar to a boiler, and steam is let in at a given pressure, while the cylinder is made to rotate by a steam-engine. The fish are steamed from twelve to fifteen minutes, then turned out and subjected to hydraulic pressure, which, of course, extracts oil and water together. This runs off through pipes into tanks, where the oil rises to the top and is taken off. There is a patent for this cylinder style, as it is called. The fish, after being pressed, are dried on large platforms (some of them covering half an acre of ground), and, after being thoroughly dried, the mass is ground into what is called fish guano, ranging in price from $25 to $35 per ton, and is considered an excellent fertiliser. These manufactories employ from fifteen to sixty men each, and consume an enormous quantity of fish. That it is a paying business I have no doubt, considering the amount invested, which is considerable, the manufactories costing from $10,000 to $60,000 each.—*W. Hill, Greenport, L.I.*

ANSWERS TO CORRESPONDENTS.

J. G.—S. Highley, 70, Dean Street, Soho.

Received, with thanks—H. N. Draper, C. R. Tichbourne.

G.—There are a number of patents for making water-gas and naphthalising it. The first is Mr. Donovan's in 1830.

T. W. D.—Not prepared artificially. You can get it at gas-works, and purify it by sublimation.

Dialyser.—It is made by immersing unsized paper, for a few seconds only, in a mixture of sulphuric acid, with half its volume of water. The mixture must be allowed to cool before the paper is immersed. It is a patent process.

Sugar and Syrups.—Mr. Pell, the author of the paper on this subject in our last Number, employed the U.S. Pharmacopœia fluid ounce, containing 455·69 grains. A slight alteration will be necessary in order to adapt his valuable results to English weights and measures.

C. R.—According to the best authority, the presence of the body named cannot be demonstrated, although there can be no doubt of its existence. You can, by concentrating a large quantity, but there are other bodies which will interfere with the reaction.

A Young Analyst.—Swedish filtering paper will not let sulphate of baryta pass, and is the best to use, as the amount of ash is very minute. For other purposes, the brown German paper answers very well; the ash of this is also very small.

R. Holliday, R., R. and S.—The report we propose to give will, of course, be strictly impartial. We are merely indebted to the plaintiffs for the loan of the shorthand writer's transcript, the defendants, who were applied to for the same, not having a reporter. An experienced member of our staff was present, and took copious notes of the trial, and the abstract will undergo his revision

THE CHEMICAL NEWS.

VOL. VI. No. 160.—December 27, 1862.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of the Red Chalk of Hunstanton, on the Coast of Norfolk, by R. CALVERT CLAPHAM.

DURING one of the excursions of the late meeting of the British Association in Cambridge, the red chalk of Hunstanton was examined; and, as I am not aware of its having been previously analysed, I obtained a specimen to analyse.

The bed of red chalk is about 3½ feet thick, and runs along the coast, distinctly seen, for some miles. It rests immediately upon the green sand, and above it lays a bed of white chalk, varying in thickness from 25 feet downwards.

Professor Phillips, of Oxford, informs me that this bed of red chalk has been traced from Speeten, in Yorkshire, to Spilsby, in Lincolnshire, and re-appears at Hunstanton, in Norfolk.

It contains many fossils, chiefly of the white chalk, and also fossils of the green sand and gault.

It is an interesting question to consider what is the cause of colour in the red chalk. Professor Phillips thinks that it is derived from decomposed glauconite or decomposed augite (both of which contain protoxide of iron and magnesia). It may also be caused by decomposed iron pyrites, as, it will be observed, it contains a trace of sulphate of lime. At Speeten it is, in some places, a soft red clay, and is used to colour bricks and rough pottery.

The following is the analysis:—

	Red chalk.	White chalk.
Carbonate of lime	80·04	95·80
Sulphate of lime	0·10	Trace only.
Peroxide of iron	9·60	1·08
Alumina	1·42	0·52
Magnesia	Nil.	0·48
Silica	9·28	2·28
Manganese	Trace.	0·11
	100·44	100·27

Walker, Newcastle-on-Tyne.

On the Prompt Estimation of the Soluble Sulphides contained in Crude Sodas, by M. H. LESTELLE.

SOLUBLE sulphides, the formation of which in the manufacture of artificial soda cannot be entirely prevented, are of great importance when viewed in connection with the commercial value of this product. It is important, also, in the course of the manufacture, to determine frequently the relative proportions of sulphides contained in crude sodas. These estimations can be made rapidly and exactly by the following method, based on the insolubility of sulphide of silver, and the solubility of all the other argentiferous salts, in presence of ammonia.

Prepare a normal liquid of ammoniacal nitrate of silver by dissolving 27·690 grammes of fine silver in pure nitric acid, adding 250 cube centimètres of ammonia, and diluting with water to bring the volume to 1 litre. Each cube centimètre of this solution corresponds to 0·010 gramme of monosulphide of sodium.

Then dissolve in water the substance to be analysed add ammonia, boil, and then add, drop by drop, by means of a burette divided into tenths of a cubic centimètre, the ammoniacal silver liquid, and a black precipitate of sulphide of silver takes place. When nearly all the sulphur is precipitated, filter, and into the filtered liquid pour a fresh quantity of silver solution, until, after repeated filtrations, a drop of this liquid produces only a slight opacity. The estimation is then at an end, and it is only necessary to read the divisions indicated by the burette, and to compare this number with that of the weight.

To estimate very small quantities of sulphide, the argentiferous liquid must be more diluted, and so that each cubic centimètre corresponds to 0·005 gramme of sulphide.

By this rapid method, which at most requires five minutes, I have estimated the amount of sulphides contained in the washings of soda and of artificial soda. By these means I have ascertained that the best sodas always contain from 0·10 to 0·15 per cent. of sulphide; while those submitted for too long a time to the action of fire, distinguished as *burnt sodas*, contain a proportion rising to 4, 5, and even 6 per cent.

Such variations affect the qualities of sodas, and, consequently, the washings destined for the manufacture of salts of soda. It is, then, necessary to make these estimations as frequently as possible. Moreover, the presence of chloride of sodium, sulphate, carbonate of soda, caustic soda, &c., makes no difference in the exactness, by reason of the solubility in ammonia of the precipitates given by these bodies with nitrate of silver.—*Comptes Rendus.*

On a Crystalline Basic Sulphate of Magnesia.

ON mixing a solution of sulphate of magnesia with chloride of ammonium and ammonia, for the precipitation of phosphoric or arsenic acid, the solution often becomes turbid, and slowly deposits a flocculent precipitate, which I have generally regarded as a little alumina due to an impurity in the magnesian salt. Having observed, however, that it occasionally became strongly adherent to the sides of the vessel, after the manner of a crystalline precipitate, I examined it with the microscope, when it appeared in the form of very distinct prismatic needles. In order to obtain a quantity sufficient for analysis, two ounces of sulphate of magnesia and one ounce of chloride of ammonia (eight equivalents of the ammonium salt to seven of sulphate of magnesia) were dissolved in twelve fluid ounces of water, and mixed with two ounces of strong ammonia; the

solution was filtered, and set aside for about twelve months in a stoppered bottle, when a hard, opaque, crystalline crust had deposited. This was well washed with water, and dried by powerful pressure between folds of filtering-paper. Under the microscope, the hard nodules presented the crystalline appearance noticed above. They were insoluble in water, but, when left for some time in contact with water, they gave up some sulphuric acid. Hydrochloric acid dissolved them with slight effervescence. After dissolving them in very little hydrochloric acid, ammonia re-precipitated, after a time, the tufts of needles; when much hydrochloric acid was employed, or when chloride of ammonium was added, no precipitate was produced by ammonia. The substance was decidedly alkaline to moist litmus paper; when heated, it evolved water, but no ammonia; on charcoal, with nitrate of cobalt, it gave a faint pink colour. Qualitative analysis detected only magnesia, sulphuric acid, water, and a little carbonic acid. For quantitative analysis, the salt was dissolved in hydrochloric acid, the sulphuric acid precipitated as sulphate of baryta, the excess of baryta removed by sulphuric acid, and the magnesia precipitated as ammonio-phosphate.

Per-centage Composition of the Salt dried at 212° F.

	I.	II.	Mean.	Calculated for the formula $6MgO.SO_3.10HO$.
Magnesia .	48·20	48·86	48·53	48·00
Sulphuric acid .	15·77	15·88	15·83	16·00
Water .	34·65	35·26	34·95	36·00

In I., the water was determined by ignition; in II., by difference. Nine equivalents of water would require 33·6 per cent. The salt, dried in air over sulphuric acid, lost 3·1 equivalents of water at 212°. An attempt to determine the carbonic acid proved it to be in too small quantity.

The crystalline precipitate deposited by a mixture of sulphate of magnesia with chloride of ammonium and ammonia appears, therefore, to consist of a basic sulphate of magnesia having the composition—

$$MgO.SO_3,5MgO,10HO + 3Aq.$$

In the exact determination of phosphoric or arsenic acid, it would be advisable to employ chloride of magnesium, or nitrate of magnesia, instead of the sulphate, which might happen to give the above precipitate.—*Charles L. Bloxam.*

TECHNICAL CHEMISTRY.

On the Quicksilver Mines of California, by Dr. L. Feuchtwanger.

Among the inexhaustible resources of California, quicksilver is one of the most interesting and profitable, for the simple reason, that the cost of mining and extracting the metal from its ore, the cinnabar, is the least expensive of all the valuable and costly ores, such as gold, silver, and copper. The yield of quicksilver is from 70 per cent. down to 25 per cent., and the mode of separation is very simple.

The new Almaden mine has sixteen furnaces, containing 20,000 lbs. of the cinnabar, and two larger ones, containing 90,000 lbs. of the ore, and producing daily 100 flasks of 75 lbs. of quicksilver each. Having visited many localities in the month of May, 1862, I feel satisfied that quicksilver will, ere long, form an important item of export to every part of the world, for the steamer on which I left San Francisco had a considerable number of flasks for China, Mexico, and England; and with the increased demand in the Washoe district for the extraction of silver, the new gold placers of Victoria and Cariboo, and all the other cinnabar mines of the Sonoma and Napa valleys, will likewise be put in requisition. The new Almaden mine has long been known to the Mexicans and Indians, the cinnabar, when ground fine, being called vermilion. It was made an article of traffic by the Indians along the coast as their red paint. From them the early white settlers of California learned the locality; and a Captain Castillero, of the Mexican service, registered the lands as his property, and formed a company for the purpose of extracting the quicksilver. Messrs. Bolton and Barron now hold the Castillero title, and an injunction which had been laid upon the mine for several years has been removed this year, and the mine is now their rightful property. From the magnitude of the mine, as well as of the smelting works, and the proper manner of operating, I feel satisfied that a more prolific mine does not exist anywhere. Along the range of these mountains, only three miles distant, is another quicksilver mine, called the Guadaloupe, which yielded considerable quantities a year ago; and the new Price and Enriquets mines, belonging to the same range of mountains, yielded 14,007 flasks of quicksilver in 1860.

A very rich and extensive deposit of cinnabar, called the Aurora quicksilver mine, occurs in the quartz of Monterey. In Sonoma county, in the vicinity of Mount St. Helena, near the famous Geyser Springs, a range of mountains, about ten miles in length, is found quicksilver ore in great abundance. The Pioneer mine is nearest the Geysers, and the pure metal may be detected everywhere running out from the rocks. Next comes the Pacific mine, which has likewise fair prospects for a solid and regular vein of the cinnabar. The Denver mine and the Dead-Broke mines have also the strongest indications of regular veins. In Knight's Valley, in Sonoma county, in Santa Clara county, in El Dorado county, are also found indications of regular mines; and in Mariposa county, at Phillips' Ferry, near the Stanislaus river, in the Mono diggings, a lead of cinnabar, thirty feet in width and seven miles long, has been discovered. At the Rogue and Klamatts rivers rich leads of quicksilver have also been discovered.

Simpson and Others v. Wilson and Another. Patents for Aniline Dyes.

In order that the entire report of this trial may be found in one volume of the Chemical News, we defer the publication until our next Number, which will be the first of Vol. VII. The length to which our Index extends would prevent the insertion of more than a very small portion this week. As the following specification will be found to be frequently referred to in the course of the trial, we add it to those published last week:—

"A.D. 1860, 26th May. No. 1300.

"*Colouring Matter.*

"Letters Patent to Georges de Laire and Charles Girard, Chemists, of the Imperial Mint, Paris, in the Empire of France, for the invention of 'A New Process for Manufacturing Red and Violet Colouring Matter.' Sealed the 9th November, 1860, and dated the 26th May, 1860.

"Provisional Specification left by the said Georges de Laire and Charles Girard at the office of the Commissioners of Patents, with their Petition, on the 26th May, 1860.

"We, Georges de Laire and Charles Girard, Chemists, of the Imperial Mint, Paris, in the Empire of France, do hereby declare the nature of the said invention for 'A New Process for Manufacturing Red and Violet Colouring Matter' to be as follows:—

"By our new process, we put into a distilling apparatus twelve parts arsenic acid and twelve parts water, and, the arsenic acid having become completely hydrated, we add ten parts kyanol (the 'aniline' of French chemists); the whole is then agitated or shaken, so as to produce a thorough mixture, forming a homogeneous, clammy, or nearly solid mass. This mass is heated at a low fire, so as to gradually raise its temperature, when liquefaction takes place. By this *modus operandi*, water and only a small quantity of kyanol (aniline) are evaporated, provided the operation is carefully conducted. At a temperature of 248 degrees Fahrenheit, a great portion of the kyanol is already changed into colouring matter, and care should be taken to keep the temperature at that point for some time; after which it is further raised, but in no instance above 320 degrees Fahrenheit. We thus obtain a perfectly homogeneous and fluid mass above 212 degrees Fahrenheit. This operation may be made to last from four to five hours. When cooled, the mass solidifies, and becomes a hard, brittle matter, of a coppery hue, similar to Florentine bronze. This matter is highly soluble in water, and imparts to it a fine pure red tint, having no admixture of violet; the intensity of this colouring matter being so great that, when boiled and concentrated, it appears altogether black.

"This colouring matter may, without inconvenience, be directly applied to dyeing fabrics, the fabric not retaining the slightest trace of arsenic. It may also be freed in an easy way from arsenic, by either of the following processes:—

"First process.—The mass is pulverised and digested with either chlorhydric or sulphuric acid, diluted with water. The clear solution thus obtained is then saturated with a slight excess of soda. Thus the colouring matter precipitates, whilst the arsenic is dissolved in the alkali. The colouring matter is next washed once or twice in cold water, when it may be filtered or decanted.

"Second process.—The colouring matter, after having been dissolved in water, is digested with a quantity of lime corresponding with the portion of arsenical compounds contained in it, the lime being slightly in excess. The colouring matter is thus precipitated as well as the arsenical compounds, which combine into insoluble calcareous salts. The precipitate both, and the solution, are then (without being separated) acted upon by either carbonic, tartaric, or acetic acid, which dissolve the colouring matter, the whole of the arsenic remaining insoluble.

"There are also other means for purifying the colouring matter obtained, such as sulphuretted hydrogen, any of which agents may be used as may be found most advantageous.

"We also obtain a violet colouring matter by changing the proportions of the arsenic acid used. For preparing the said violet matter, we take twenty-four parts arsenic acid, twenty-four parts water, and ten parts kyanol (aniline). The process is precisely the same as for the red colouring matter hereinbefore described; and the whole of the kyanol (aniline) is thus transformed into soluble colour, which is fit for directly dyeing violet, pensée, and granate red; but, when used for silk stuffs, the colouring matter should previously be purified. The purifying process is easily performed by means of naphtha (benzine), which separates the violet matter from the remainder. There are also different other ways of purifying the same, as for the red colour hereinbefore described.

"The red and violet colouring matters obtained by the process hereinbefore described are nearly equal in quantity to the kyanol (aniline) employed.

"In conclusion, we do not confine ourselves to any of the particular proportions hereinbefore stated; but what we consider as novel in our process is the use of arsenic acid for transforming kyanol (aniline) into red and violet colouring matter.

"Specification in pursuance of the conditions of the Letters Patent, filed by the said Georges de Laire and Charles Girard in the Great Seal Patent Office, on November 22, 1860.

"Now know ye, that we, the said Georges de Laire and Charles Girard, do hereby declare the nature of our said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

"By our new process we put into a distilling apparatus twelve parts arsenic acid, and twelve parts water, and the arsenic acid having become completely hydrated, we add ten parts of kyanol (the 'aniline' of French chemists). The whole is then agitated or shaken, so as to produce a thorough mixture, forming a homogeneous, clammy, or nearly solid mass. This mass is heated at a low fire, so as to gradually raise its temperature, when liquefaction takes place. By this *modus operandi*, water and only a small quantity of kyanol are evaporated, if the operation is conducted with the proper care. At a temperature of 248° F., a great quantity of the kyanol or aniline is already converting into colouring matter, and care should be taken to keep the temperature at that point for some time, after which it is further raised, but in no instance above 320° F. We thus obtain a perfectly homogeneous and fluid mass above 212° F. This operation lasts from four to five hours. When cooled, the mass solidifies and becomes a hard, brittle matter, of a coppery hue, similar to Florentine bronze. This matter is highly soluble in water and other solvents, such as alcohol, and imparts to them a fine, pure red tint, having no admixture of violet, the intensity of this colouring matter being so great, that after having been boiled and concentrated it appears altogether black.

"This colouring matter may, without inconvenience, be directly applied to dyeing or otherwise colouring fabrics and other substances, the substance thus coloured not retaining the slightest trace of arsenic. The arsenic may also be eliminated in an easy way by either of the following processes:—

"First process.—The mass is pulverised and digested with either chlorhydric (hydrochloric) or sulphuric acid, diluted with water. The clear solution thus obtained is then saturated with a slight excess of soda or carbonate of soda; thus the colouring matter precipitates, whilst the arsenic is dissolved in the alkali. The colouring matter is next washed once or twice in cold water, when it may be filtered or decanted.

"Second process.—The colouring matter, after having been dissolved in water, is digested with a quantity of lime corresponding with the portion of arsenical compounds contained in it, the lime being slightly in excess.

The colouring matter is thus precipitated, as well as the arsenical compounds, which combine into insoluble calcareous salts. The precipitates both, and the solution, are then (without being separated) acted upon by either of the carbonic, tartaric, or acetic acids, which dissolve the colouring matter, the whole of the arsenic remaining insoluble.

"There are also several other means for purifying the colouring matter obtained, such as sulphuretred hydrogen, 'benzine,' any of which agents may be used as may be found most advantageous.

"We also obtain a violet colouring matter, and also a combination of blue and other colouring matter, by merely changing the proportions of the arsenic acid used. Thus, instead of employing the proportions above stated, if we act with eighteen, twenty, and twenty-four parts of arsenic acid on ten parts of aniline, or a quantity of any salt containing ten parts weight of aniline, a colouring matter is produced that is more or less violet, tending towards the pure blue, and the matter thus obtained may be used directly, as it is, or the blue ingredient may be separated from it, and be used as such.

"We now have to point out the following concomitant, but characteristic and important features of our invention, as hereinbefore specified, viz,—

"First, establishing the proper limits of temperature within which the reaction has to be carried on, in order to prevent the production of secondary substances differing from the colouring matter to be produced.

"Second, the precise atomic proportions in which the reactive bodies must be used, so as to prevent the production of resinous matter, and thus convert the whole (or nearly so) of the aniline into a colouring matter of the shade required.

"And what we distinctly claim, either in connexion with or without the concomitant features above ascertained, as novel, and secured to us by the hereinbefore in part recited Letters Patent, is the use of arsenic acid for converting aniline or kyanol into colouring matter."

PHARMACY, TOXICOLOGY, &c.

New Medicines.

"*Cras credemus, hodie nihil.*"

"Let us wait and see what will happen to-morrow—we will sleep upon it for the present."—*Proverb.*

FASHION, insinuating Dame that she is, creeps into everything. It is of no use slamming to the doors, be they ever so heavy or large. She waits outside of the colleges, pins some leviathan by the button, and walks in arm-in-arm, and who has the temerity to stop her then? She is withal as fickle a chameleon as you could well wish for; the robes of to-day are changed to those of another hue to-morrow. *Ah, mon cher Docteur Sangrado*, thou art not dead. Dr. Smellfungus, your sketch of "the famous Dr. L—" is only a passing phase of professional peculiarity; you have your individual singularity, but you are not alone in the world. But what is the mania, fashion, or whatever you choose to term it, of the present day? It is to discover so-called new remedies. The vegetable and even the animal creations are being ransacked for them. Plants from America, Hindostan, &c., come tumbling down upon us like an avalanche. The medical world is inundated with remedies principally culled from the vegetable world, which have names so excruciating, that the modest medical man feels a nervousness in asking for them. The kitchen-garden gives up its culinary position, and is converted into a *hortus medicus*. Then we pass on to green lanes, where we find the ornaments of the hedge side, the companions of the roads, the clustered smilers of the banks, paying tribute to Esculapius. One peculiarity of the eclectics from whom we have many of the new remedies (and which latter circumstance may account for most of them being of vegetable origin*) is, that they seem to expect that like therapeutical effects ought to be expected from members of the same natural orders; therefore, by : : : : acetum scillæ being a good expectorant, pickled onions would be excellent for bronchitis; but,

Nihi simile est idem,

at least it is so uncertain that we cannot accept it as a rule; for we have the same vegeto-alkali, caffeine ($C_{16}H_{10}N_4O_4$), occurring in the orders *Camellieæ*, *Rubiaceæ*, *Sapindaceæ*, *Celastrineæ*, &c.; whilst, *vice versa*, plants allied in external form secrete within their juices active principles having quite different compositions and therapeutical effects, such as the parsnip and hemlock. The ranunculaceæ contain almost every class of medicines known—astringents, cathartics, emollients, vesicants, sedatives, stimulants, &c.

As regards the novelty of some of the so-called new medicaments, we cannot say much; but that there is nothing new, &c., is a proverb somewhat musty. The preponderance of them, strange to say, is of ancient date. They are not exotics, the properties of which are not known, but are substances, many of which were cooked and hashed up by our forefathers until they were done to tatters, and then became obsolete. We append a list of some of the best known of these, taken from a circular published by a London manufacturing house. It is called "An Account of recently-introduced Remedies." Against each article we have placed some remarks, principally taken from an edition of the "Pharmacopœia Universalis," published thirty years ago, and a few other works. No doubt, more ancient references to these articles could be found, but these were at hand, and we consider them quite sufficient for our present purpose.

Names, &c., of Plants occurring in the above Circular.	*Remarks, &c., occurring in the Pharmacopœia Universalis and other works.*
Apiol—"Is an educt† from Petroselinum Sativum (Parsley").	Parsley officinal in 28 Pharmacopœias. Formulæ for "Oleum Petroselini Ætherium" in Dispensatorium Brunsvicense, 1777.
Datura Tatula—"In asthmatic complaints."	In use in 1820 for the same complaints, as D. stramonium.
Geranium Maculatum—"Astringent."	"Astringent."—American, French, and other Pharmacopœias, 1820.
Prysalis Alkekengi—"Aperient."	Used by the ancients as an aperient, &c.
Spigelia Marilandica—"Anthelmintic."	Officinal in the London Pharmacopœia, 1824. "Anthelmintic. Now scarcely ever employed in this country." — Christison's Dispensatory, 1842.
Triticum Repens—"A substitute for buchu. Found useful in bladder affections."	Officinal in 24 Pharmacopœias in 1824. Preparations "diuretic, emollient, and slightly astringent. Used in bladder affections."

* One of the precepts of the eclectics is, that the vegetable kingdom contains all the medicaments necessary for all known diseases, and generally condemn all mineral preparations.

† Ethereal oil or extract.

Xanthroxylum Fraxineum.	Popular remedies for chronic rheumatism in 1820.
Ulmus Fulums—campestris, "in cutaneous diseases."	"In cutaneous diseases" in 29 Pharmacopœias in the year 1820. "Now fallen into disuse."—Pereira.

But enough of this; our coin has its obverse, on which is legibly inscribed the axiom, that the metal must be base indeed that contains no gold. Now, the novelty mania will be of inestimable value to the science of medicine, from the following reasons:—There are about 130,000 species of plants properly classified, and every day is adding to the store, all of which contain some active principle or principles in the form of vegeto-alkalies, indifferent principles, acids, oils, resins, &c., each active principle having as definite and constant a chemical composition as calomel or hydrocyanic acid. Out of such a number of chemical compounds, each of which has its own peculiar action upon the system, and which are placed at our disposal, is it not extraordinary that the number of plants used in the European materia medica does not exceed 400?—whilst those in general use might be counted at one-tenth of this, and the circle seems, amongst the regular practitioners, to be narrowing each day. Why is this? From continual experience, one astringent is found to fulfil all the advantages of A, B, or C. It is easily procured, and is adapted better than A, B, or C for general use. A, B, or C goes gradually more and more out of use until it becomes obsolete; but, of course, for this reason, the medicaments in general use are the best at our disposal. Some of our old friends have been handed down to us from the Romans, Grecians, Egyptians, and Jews; their very age is a proof of their health and vigour; but what just reason have we to suppose that, amongst the thousands of exotics and other plants with which we are medicinally unacquainted, there may not be medicaments even superior to our old favourites, which are but as grains of sand upon the sea shore. One cannot but be impressed with this upon reading the interesting papers entitled "Notes on Chinese Materia Medica," by Dr. Hanbury, *Pharmaceutical Journal;* "On the Useful Plants of Paraguay," by Domingo Parodi; "On the Anthelmintics and other Medicinal Plants of Abyssinia," by Dr. Courbon, *Repertoire de Pharmacie*, and such like papers; but we must confess that we do not see the use in unearthing dusty obsolete remedies, which have been for years in the hands of discriminating and educated men, whose only business was to examine practically their therapeutic properties. The introducers of such remedies as anacuhuite wood, sarracenia purpurea, podophyllin, &c., deserve our best thanks, even if, in time to come, their virtues are found to be exaggerated. Our army and navy surgeons have great facilities for introducing useful things to the notice of their brethren at home, even if they have not the time or inclination to experimentalise upon them themselves.

Under the present circumstances, can this fashion have any other than a beneficial result? We think not. Every plant brings forth its hundreds and thousands of seeds, which, if they all germinated and had their usual existence, would have exterminated the animal creation ages ago. Why, then, is this profusion? The seeds and developed plants are provided only as part of a perfect whole—not as a creation intact in itself—but in a degree as an essential to the higher organisms of animal life. Are we not dependant on the superfluity of these seeds for the very staff of life? If, then, we recognise the theory of perfect design, why are the juices of the plants made to assimilate certain elements, and group them in such a way as to form distinct chemical compounds, to which chemical compounds is due the edible or medicinal properties of the plant? As certain vegetables are considered as intended for our nutrition, so may others be viewed as intended to maintain the natural balance of our system. The dog in illness seeks the grass; and the herbs of the field form the most powerful remedies of man. Each plant has its allotted essence. Let us, then, hail the movement with delight which gives us an insight as to what these essences are applicable. But, in the meantime, we are not to believe until things have been well tried and proved. There are many to pick from, but the choice will fall upon few. We will wait and see. C. R. C. T.

MISCELLANEOUS.

Royal Institution.—The following lectures will be delivered by Professor Frankland, F.R.S.:—On Tuesday, December 30, at 3 o'clock, on "Air and Water" (juvenile lecture). On Thursday, January 1, at 3 o'clock, on "Air and Water" (juvenile lecture). On Saturday, January 3, at 3 o'clock, on "Air and Water" (juvenile lecture).

Icelandic Fuel.—The turf is inferior; wood is too scarce and valuable to be much used for fuel. Coal costs 5*l.* per ton, is retailed in small packages at about 2d. per pound, and is only used in smithies. When turf is not available, the Icelanders, like the Arabs, burn dried cows' dung; and on the coast, where even that is scarce, they use the dry carcases of sea-fowl. Why do they not burn dried sea-weed, which is extensively used for fuel in the Channel Islands? The scarcity of fuel tempts people to crowd together for heat; sometimes fifteen or sixteen people in one small sleeping apartment, and that often placed over another where cattle are kept. The state of such an atmosphere may be imagined, while many dirty habits and the frequent recourse to stimulants are thus accounted for. Nor will any one wonder much, although there were no other causes, that, in one district of the south, 75 per cent. of all the children born die before they complete their twelfth month.—*Pen and Pencil Sketches of Faroe and Iceland. By A. J. Symington.* Longmans, 1862.

ANSWERS TO CORRESPONDENTS.

J. D.—Normandy's "Handbook of Commercial Analysis" is published by G. Knight and Sons, 2, Foster Lane.

J. D.—All our volumes are kept in stock bound, except Volumes I. and II., which are out of print. You should have no difficulty in procuring any volume through a news-agent or bookseller. The postage of a volume direct from the office is 8d.

J. W.—1. Full accounts of the syrups of the superphosphates wil be found in Nos. 15 and 16 of the Chemical News. The best formula for a solution of the superphosphate of iron to be used in making the syrup is the following:—

Take of sulphate of iron in crystals	ʒiij.
phosphate of soda	ʒiij.
carbonate of soda	ʒiss.
water	f. ʒiss.
phosphoric acid, P.L.	f.ʒxxj.

Rub the phosphate and carbonate of soda together to a fine powder, then add the sulphate of iron, and continue the trituration, adding the water gradually, until a fine blue mass is obtained. Well wash on a filter and drain, and while moist place in a measure, and, if necessary, add water to make the whole occupy six fluid ounces, then dissolve in the phosphoric acid, and filter the solution which is to be kept for use. Five fluid ounces of this solution added to nine ounces of simple syrup will give a syrup of superphosphate of iron containing one grain of phosphate of iron and sixteen minims of phosphoric acid in a fluid drachm. 2. Protonitrate of mercury is made by treating an excess of mercury with cold diluted nitric acid. To make the ointment, the crystals are dissolved in a *small quantity* of warm water, and mixed with lard and oil, as in the Pharmacopœia ointment. You can use the quantity of nitric acid ordered in the Pharmacopœia with twice the weight of mercury ordered, and take the quantities of oil and lard directed.

Received—Placebo; M. P. T., next week; Quero; B. S.; J. P. Answers deferred.

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